MEMOIRS

of the

NATIONAL MUSEUM OF VICTORIA

MELBOURNE :: AUSTRALIA

(World List abbrev. Mem. Nat. Mus. Melbourne)

No. 19

Issued March, 1955

R. T. M. PESCOTT, M.Agr.Sc., F.R.E.S., M.I.Biol.
Director

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CONTENTS

NOTES ON STOMATOPOD CRUSTACEA FROM VICTORIA AND TASMANIA

By William Stephenson, Professor of Zoology, University of Queensland

INTRODUCTION

In a previous paper (Stephenson, 1952) it was noted that, of the 34 species of *Stomatopoda* recorded from Australia, only four were known from Victoria and one from Tasmania. A second Tasmanian species has since been found by Guiler (1952). It was suspected that additions would result from examining material from Victorian and Tasmanian museums, and this has proved to be the case.

The Directors of the following museums most kindly forwarded their material to Brisbane for examination:— National Museum of Victoria, Melbourne (Mr. R. T. M. Pescott); the Tasmanian Museum, Hobart (Dr. J. Pearson); and the Queen Victoria Museum and Art Gallery, Launceston (Dr. I. Thomson). Especial thanks are due to Drs. Pearson and Thomson for permission to publish results in the present journal.

Only specimens from Victoria or Tasmania, or suspected to have been collected there, are included in the present report. References following specific names are purposely reduced in number, and especially by the exclusion of the majority of authors prior to Kemp (1913). Lengths of specimens are measured mid-dorsally from the posterior end of the telson to the anterior end of the carapace, excluding the rostrum. Owing to curvature or extensibility of many specimens, these measurements are only accurate to about ± 1% or 1 mm. which ever is larger.

SQUILLA MILES HESS

Squilla miles, Hess, 1865, Arch. f. Naturges, XXXI. (1), p. 169, pl. vii. fig. 21; Kemp, 1913, Mem. Ind. Mus., IV (1), p. 36; Odhner, 1923, Med. Göteb. Mus. Zool. Avd., 30, p. 1, figs. 1-3; Hale, 1924, Rec. S. Aust. Mus., II. (4), p. 492, pl. xxxii. fig. 1, text fig. 381 a–i.

Squilla pectinata, Tate, 1883, Trans. R. Soc. S. Aust., VI., pl. 50, pl. ii., figs. 2 a-d.

National Museum, Melbourne.

Material: Eight males, 75–140 mm.; nine females, 57–126 mm.; one sex indeterminate c.110 mm.

Localities: Saltwater River; Geelong; Phillip Is.; Port Phillip, from stomach of flathead; Lakes Entrance; Hobson's Bay, Sorrento; Western Port Bay; Loutit Bay; Queenscliff; two specimens localities unknown.

Tasmanian Museum, Hobart.

Material: Two males, 39 mm., 83 mm.

Locality: Eaglehawk Neck, S.-E. Tasmania.

Queen Victoria Museum, Launceston.

Material: Two specimens.

Localities: George Town, R. Tamar, fish stomach; Lady Barren Is., Bass Str.

Comments: Apparently the dominant stomatopod in Victorian waters, from whence it has been recorded by Miers (1880). It is also common in S. Australia (Tate, 1883; Odhner, 1923; Hale, 1924; Hale, 1927; Hale in personal letter); and is apparently not uncommon in Tasmania, as judged from Guiler's (1952) and the present records.

Collections at the Australian Museum, Sydney, and the Western Australian Museum, Perth, have been examined through the kindness of their Directors (Dr. Walkom and Mr. Glauert respectively) and the dominant stomatopod in these collections is not *S. miles* but *S. laevis* Hess.

SQUILLA INORNATA TATE

Squilla inornata, Tate, 1883, Trans. R. Soc. S. Aust., VI., p. 51, pl. ii. figs. 3 a–e; Stephenson, 1952, Mem. Qd. Mus. (in the press).

Squilla affinis var *intermedia,* Nobili, 1903, Bull. Mus. Zool. Anat. Comp. Torino, 18 (455), p. 38.

Squilla oratoria var *perpensa,* Kemp, 1913, Mem. Ind. Mus., IV. (1), p. 70, pl. v. figs. 57–9.

Squilla oratoria var *inornata,* Hale, 1924, Rec. S. Aust. Mus., II. (4), p. 495; Chopra, 1935, Rec. Ind. Mus., XXXVI, p. 24; Gravier, 1937, Ann. Inst. Oceanogr., XVII., p. 183, fig. 6; Holthius, 1941, Temminkia, VI., p. 248; Lui, 1949, Contrib. Inst. Zool. Nat. Acad. Peiping, V. (1), p. 37, figs. 2 a, b.

Squilla oratoria inornata Tweedie, 1935, Bull. Raffles Mus., p. 45.

Tasmanian Museum, Hobart.

Material: Male, 63 mm., no locality data.

Comments: This species has been recorded from S. Australia (Hale, 1924), Queensland (Hale, 1924; Stephenson, 1952) and N. Australia (Miers, 1880). So far there are no records from Tasmania or Victoria, but the present specimen suggests that Tasmanian specimens may be found at a later date.

HEMISQUILLA STYLIFERA (H. M. EDWARDS).

Gonodactylus styliferus, H. M. Edwards, 1837, Hist. Nat. Crust., 2, p. 330, pl. xxvii., figs. 9–14.

Hemisquilla stylifera, Kemp, 1913, Mem. Ind. Mus., IV. (1), p. 106, pl. vii., figs. 84–5; Schmitt, 1940, Allan Hancock Pac. Exped., 5 (4), p. 182; Stephenson, 1952, Mem. Qd. Mus. (in the press).

Tasmanian Museum, Hobart.

Material: Three specimens, Reg. Nos. E.1345–47; the last sighted, male 140 mm.

Locality: Victorian coast.

Comments: Almost certainly coll. "Endeavour."

LYSIOSQUILLA PERPASTA HALE

Lysiosquilla perpasta, Hale, 1924, Rec. S. Aust. Mus., II. (4), p. 497, pl. xxxiii., fig. 1, text fig. 382; Hale, 1927, Crust. S. Aust., pt. i., p. 33, fig. 23.

National Museum, Melbourne.

Material: Two males, 26 and 30 mm.; one female 33 mm.

Localities: Flinders; Shoreham, Western Port Bay.

Notes: The 26 mm. male (Shoreham) has six teeth on each raptorial claw.

Tasmanian Museum, Hobart.

Material: Two males 30 mm., 30 mm.; female 32 mm.

Locality: Tasmanian Peninsula.

Three additional Tasmanian specimens have been examined by the author. These were collected by Professor Hickman " under stones at low tide, Eaglehawk Neck, S.-E. Tasmania."

Comments: New records for Victoria and Tasmania.

LYSIOSQUILLA VERCOI HALE

Lysioquilla vercoi, Hale, 1924, Rec. S. Aust. Mus., II. (4), p. 499, pl. xxxiii., fig. 2, text fig. 383; Hale, 1927, Crust. S. Aust., pt. i., p. 33, fig. 24; Stephenson, 1952, Mem. Qd. Mus. (in the press).

Tasmanian Museum, Hobart.

Material: Male, 54 mm.

Locality: Coles Bay, Tasmania.

Notes: Ten teeth on the left and eleven on the right raptorial dactylus.

Comments: New Tasmanian record.

LYSIOSQUILLA OSCULANS HALE

Lysiosquilla vercoi var *osculans,* Hale, 1924, Rec. S. Aust. Mus., II. (4), p. 501, pl. xxxii., fig. 3, text fig. 384.

Lysiosquilla osculans, Hale, 1927, Crust. S. Aust., pt. i., p. 34, fig. 24.

National Museum, Melbourne.

Material: Male, 35 mm. female c.40 mm., one sex indeterminable (damaged specimen) 37 mm.

Localities: Western Port Bay (the female); others unknown.

Comments: Recorded from Mornington, Victoria, July 6, 1927, by Mr. Hale (personal communication) but there are no published records from Victorian localities.

Discussion

The following table which includes manuscript records, summarizes the existing information regarding the stomatopod fauna of Victoria and Tasmania. Six species have been recorded from the former state, of which five are indigenous to Australia. Tasmanian fauna is increased to four species (excluding *S. inornata*) of which three are indigenous. It appears that South-Eastern Australia contains few stomatopod species, dominated by indigenous forms, and this is in distinct contrast with the Queensland fauna (Stephenson, 1952) which is rich in species and dominated by an " overflow " of Indo-Pacific forms.

Species	*State Records*	*Authority*
Squilla miles	Victoria	Miers, 1880; present work.
	Tasmania	Guiler, 1952; present work.
S. laevis	Victoria	Miers, 1880.
	Tasmania	Not recorded.
S. inornata	Victoria	Not recorded.
	Tasmania	No definite record but see present work.
Hemisquilla stylifera	Victoria	Kemp, 1913; Stephenson, 1952; present work.
	Tasmania	Hale, 1924.
Lysiosquilla perpasta	Victoria	Present work.
	Tasmania	Present work.
L. vercoi	Victoria	Stephenson and McNeill (in ms.).
	Tasmania	Present work.
L. osculans	Victoria	Hale (in ms.); present work.
	Tasmania	Not recorded.

References

GUILER, E. R. (1952): "A list of the Crustacea of Tasmania." Rec. Q. Vic. Mus., Launceston, Vol. III., No. 3, pp. 15–44.

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MIERS, E. J. (1880): "On the Squillidae." Ann. Mag. Nat. Hist., Ser. 5, Vol. V., pp. 1–30, pp. 108–27, pls. i.–iii.

ODHNER, T. (1923): "Indopazifische Stomatopoden." Med. Göteb. Mus. Zool. Avd., Vol. 30, pp. 1–16, 1 pl.

STEPHENSON, W. (1952): "Notes on the Australian Stomatopoda (Crustacea) in the Collections of the Queensland Museum." Mem. Qd. Mus. (in the press).

TATE, R. (1883): "Descriptions of some New Species of *Squilla* from South Australia." Trans. Proc. Roy. Soc. S. Aust., Vol. VI., pp. 48–52, pl. ii.

TAXONOMY, MORPHOLOGY AND BIOLOGY OF SERICOPHORINE WASPS

With Diagnoses of Two New Genera and Descriptions of Forty New Species and Six Sub-species

By Tarlton Rayment, F.R.Z.S., Honorary Associate in Entomology, National Museum of Victoria.

Plates I–II.; Figs. 1–9

Introduction

The fossorial sericophorine wasps investigated in this research are endemic to Australia, and of economic importance. It is, therefore, rather surprising that they should hitherto have received so little attention by students of the HYMENOPTERA.

The long delay in investigating the biology—the first species was described as far back as 1851—may be due to their inconspicuous habits, for most of the life of the female is spent in sinking shafts in sandy ground, a labour at which she is exceedingly efficient. Since her prey, (flies), is abundant, little time is given to hunting and garnering in the field, consequently, few opportunities are present to observe her actions.

The hunting is interrupted by hurried visits to the flowers of certain plants, chiefly Myrtaceae (for the adults are strictly vegetarian in their diet) and since the blossoms are often borne high on trees, the harvesting wasps are rarely observed. The " meat " is reserved exclusively for the young.

The gross morphology is singularly stable, and good specific characters are neither easily discovered nor described. Since they are all microscopic, the work of the taxonomist is of a critical nature, and the observation of the biology places a strain on the patience of the investigator.

Stability of structure is usually accepted by evolutionists as evidence of early origin, and the fact that one species described in this paper is from a Tasmanian locality, indicates that the wasps had extended to the island before its separation from the mainland by Bass Strait.

Acknowledgments

The author is indebted to the courtesy of Dr. A. J. Nicholson, Chief of the Division of Entomology, C.S.I.R.O., Canberra, and the Directors of the several State museums and Agricultural Departments for affording him the opportunity to study the specimens in the collections under their control.

Professor J. Beaumont, Musée Zoologique, Lausanne, Switzerland, graciously assisted by comparing specimens with Saussure's types standing at Geneva, and in making typescripts of papers not available in Australia.

Dr. G. Arnold, Rhodesia Museum, South Africa, kindly presented the author with copies of publications not obtainable in Australia, and also specimens of *Paranysson* for comparative studies.

Mr. R. T. M. Pescott, Director, and Messrs A. N. Burns and C. Oke, entomologists, of the National Museum of Victoria, have assisted the author with the loan of specimens and literature, the checking of references, and extended many other courtesies.

Dr. J. van der Vecht, Director of the Experimental Plant Station, Bogor, Java; Mr. K. Sakimura, Pineapple Research Institute, Hawaii, and Mr. H. H. van Zwaluwenburg, Experimental Station, Hawaiian Sugar Planters Association, very kindly made transcriptions, and presented the author with copies of publications not obtainable in Australia.

The observations of Mrs. Rica Erickson, Bolgart, Western Australia, and Mr. Norman Rodd, Sydney, New South Wales, confirmed those of the author, and added to our knowledge of the wasps; Mr. Keith McKeown, Australian Museum, extended many courtesies; Mr. Cliff Beauglehole, Gorae West, Victoria, collected specimens of the wasps, and supplied notes on the plants visited by the females in his district.

The author's researches in the HYMENOPTERA of Australia are assisted by a grant from the Trustees of the Commonwealth Science and Industry Endowment Fund, and the officers of the Information Section, C.S.I.R.O., have been helpful in technical matters.

The author now desires to express his appreciation of the many courtesies and assistance received from fellow-workers in the science, both in Australia and overseas. Miss Lynette Young, Field Naturalists' Club of Victoria, very graciously assisted in checking references, typescripts, and printers proofs.

Census of Species

Dalla Torre, "*Catalogus Hymenopterorum*", listed only five species in this sub-family. This research adds two new genera; 40 new species; and six new sub-species, bringing the total number of sericophorine wasps to 43 valid species.

Distribution

The early recorders of locality could do little better than indicate " New Holland " for Australia, although " Swan River " is given for *Sericophorus bicolor* Smith. Species in the author's hands were collected in Queensland (11); New South Wales (15); Victoria (12); South Australia (6); Western Australia (8); Northern Territory (1); and Tasmania (1); while no records have been received from either New Zealand or New Guinea. Now that these insects are better known, there is little doubt that more new species will be taken by collectors, for it is evident that these beneficial wasps are not rare, but widely distributed over the several states.

Collectors

The names of the first collectors are not now available, for the early taxonomists frequently did not include them in their descriptions—perhaps because they did not possess the information. The more recent collectors are indicated under the several specific descriptions included in this paper.

Plants Visited

By Adult Wasps for Pollen and Nectar

Eucalyptus ficifolia	Myrtaceae	*S. teliferopodus*	Sandringham, V.
Garden flowers	Various	*S. rufipes*	Kerang, V.
Bursaria spinosa	Pittosporaceae	*S. teliferopodus*	Warburton, V.
Eucalyptus sp.	Myrtaceae	Subsp. *okiellus*	Melton, V.
E. redunca var. *elata*	.. ..	*S. sydneyi*	Bolgart, W.A.
Bursaria spinosa	Pittosporaceae	*S. spryi*	Mordialloc, V.
B. spinosa	.. ..	*S. claviger*	.. .. V.
Leptospermum sp.	Myrtaceae	*S. rufipes*	Mt. Victoria, V.
L. scoparium	.. ..	*S. chalybaeus*	Gorae West, V.
L. scoparium	.. ..	*S. cliffordi*	Gorae West, V.
Eucalyptus Kitsoniana	.. ..	*S. cliffordi*	Gorae West, V.
Eucalyptus sp.	.. ..	*S. gracilis*	Glen Aplin, Nth.Q.
Eucalyptus sp.	.. ..	*S. elegantior*	Bolgart, W.A.
Lomatia sp.	.. ..	*S. chalybaeus*	Lane Cove, N.S.W.
Baeckea sp.	.. ..	*S. rufipes*	Fraser Pk., N.S.W.
Kunzia ambigua	.. ..	*S. rufipes*	Woollahra, N.S.W.

TAXONOMIC POSITION

Family SPHECIDAE

Subfamily SERICOPHORINAE

Genus SERICOPHORUS Shuckard, Nomen nudum

(*Sericum*—silk, *fero*—I bear)

Lardner's Cabinet Encyclo., VII., p. 181, 1840

SERICOPHORUS Smith

Ann. Mag. Nat. Hist. (2) VII., p. 32, 1851

TACHYRRHOSTUS Saussure

Mem. Soc. Phys. Hist. Nat. Genevé, XIV., I., p. 24, 1854
Isogenotypic with SERICOPHORUS Smith

Sericophorus chalybaeus Smith
Ann. Mag. Nat. Hist. (2) VII., p. 32, 1851
Syn. *Tachyrrhostus cyaneus* Saussure
Melang. Hymen., fasc. I., p. 69, 1854

NEW CHARACTERS

Males were unknown to the above authors, and no worker appears to have dissected a female, consequently mouth-parts and genitalia could not be described. The author is more fortunately situated, and has been able to dissect both sexes. This research demonstrated that the most stable specific characters are of value in the order given—structure of epinotum; form of penis-valves of genitalia; clypeal teeth or nodes on anterior margin; disposition of tarsal rakes; pygidial plates and apical sterna of the abdomen; distance between recurrent and intercubitus nervures.

The microscopic structure of the propodium almost defeats intelligible description, thus making it necessary to include a number of drawings—although these fall far short of adequate representation, yet they will assist the student in his determinations. All the parts are presented in oblique dorsal views to show the declivity as well as the dorsum of the epinotum.

The species may be separated in two distinctive groups—one comprised of larger bluish or greenish wasps, e.g. *S. chalybaeus* Sm.; the other of smaller black insects, often ornamented with red and yellow markings e.g. *S. relucens* Sm., with *S. pescotti* Raym. annectant between *S. nigror* Raym. and *S. relucens* Sm.

That the genus is a difficult one for the taxonomist is demonstrated by the labels on certain of the specimens—only one specimen was determined correctly; indeed, one was labelled *Megachile*, and another *Halictus*.

It seems advisable, in the light of this research, to amplify Smith's rather meagre generic diagnosis.

Sericophorus, Shuckard et Smith, stat. nov.

Head transverse, not so wide as the thorax, minus tori; insertion of scapes low on the face, and joined by a transverse suture on which the frontal carina often terminates; vertex excessively narrow, and the lateral ocelli not compressed. The clypeus of the females bears on its anterior margin two or three minute nodular teeth which appear to be correlated to the inner incisure of the mandibles, on the outer margin of which is a larger node; anterior margins of the compound eyes almost parallel, and converge on the vertex only slightly. Flagellum short, clavate, median segments often produced to a node; apical segment usually modified, especially in the males; the frons bears a tubercle, either large or small, and supraclypeal area not defined; the small genae are unarmed, and there is no malar area; labrum small and oval, with a fringe of stiff setae; antennae with twelve segments in both sexes.

The mouth-parts are elemental, glossa short and deeply emarginate, bearing numbers of short stout truncated setae; four segments in the labial palpus and six in the maxillary; galea with comb on inner surface; mentum short and broad; salivarium not conspicuously developed, and when considered in relation to the ducts of the pharyngeal plate, it would appear that glandular secretions play little part in the physiology of the species, and none has been observed. The

stipes are broadly developed, but short, and the galea conspicuously banded with darker colour. (Pl. I., No. 1); 24 minute organs on anterior margin of glossa. (Pl. I., No. 3.)

The prothoracic collar is appressed on the scutum, and dorsally appears as a mere line; median scutal and parapsidal lines are conspicuous; scutellum often tuberculate; postscutellum small; propodium or epinotum large; and laterad of the dorsum more or less rugose; the cruciform incisure is divided into a number of quadrate pits by short transverse rugae.

Abdomen smaller than the thorax, basal segments widest, and sometimes produced to a dorsal tubercle, apical segments slender, with a pygidial plate close-set with spines, and the flexible abdomen may be thrust far forward to bring the short curved sting into action; the gonostyli are well developed, with a microscopic vestiture of hair.

The genital capsule of the smaller male is peculiar, the dentate penis-valves (Michener) offer a specific character (pl. I., No. 6); gonostyli slender and hairy.

Legs stout; tibiae armed with rows of spiculae, anterior femur strongly developed, although all are adapted for efficient digging; the anterior basitarsi bear a strong rake of spines; the strigilis is of primitive character, and the two hind calcariae are unequal in length; the fifth tarsus is large, and the pulvillus excessively so. Its function is discussed elsewhere, but it may be spread like a close net when digging.

The neuration of the wings is distinctive, for the first recurrent enters the first cubital cell, the second cubital cell is almost an equilateral triangle, and receives the second intercubitus nervure usually beyond the middle; pterostigma well developed, and the dozen or more hamuli indicate a long range of flight. Rare specimens have only two cubital cells.

The insects are almost naked, and most of the simple hair is found about the metathoracic region. In the green species, the integument is almost entirely sericeous; in the black species the appressed hair has a metallic lustre. The wasps are of medium size, but of robust stature, and females easily outnumber males in all collections; only three described species are represented by both sexes. Males have only the anterior angle of the clypeus produced to a small tooth, and lack the lateral nodes of the females; they may be known by this character.

The cruciform structure of the epinotum or propodium has parallels in several genera of SPHECIDAE, and Arnold (1940) illustrates the triangular structure of *Psenulus patei* Arn. and *P. stevensoni* Arn., two Ethiopian wasps with a rugose dorsum not unlike that of *Sericophorus rugosus* Raym. Similar structures are present in *Dolichurus secindus* Arn. and *Alysson seyrigi* Arn., and certain species of *Crabro*.

The pleural or episternal suture of the mesopleuron in *Sericophorus* is also conspicuous in many other SPHECIDAE, and as Doctor Arnold rightly points out, the suture is present in bees in the genus *Hylæus* (fig. 2, No. 1).

Phylogeny

Students of the HYMENOPTERA agree that bees are derived from fossorial wasps, and *Sericophorus* appears to be closer to the APOIDEA than any other genus in the family SPHECIDAE, for there are many parallels in morphology, food, architecture and behaviour. (See *Astaurus*, gen. nov.)

The wasps are not, of course, endowed with plumose hairs, only the simple ones of hunting insects; they are therefore precluded from gathering a large load of pollen. However, that physical limitation should not of itself debar the wasps from supplying their young with pollen, because bees in the genera *Hylaeus*, *Hylaeoides*, *Meroglossa*, and indeed several other genera, are no better equipped with harvesting implements, consequently, they are compelled to carry pollen mixed with nectar in the honey-sac. The grains are swept into the mouth with the brushes of the anterior tarsi.

The head of the wasps and the bees is small; the genae but little developed, and the ocelli, compound eyes, and antennae are similar to those of *Paracolletes*, the most primitive of the bees, and with which the author proposes to draw comparisons.

The scapes of the wasps are inserted much lower down on the "face", so that the subantennal area is eliminated; the clypeus, too, is much shorter, but the small narrow oval of the labrum is similar in the two insects, so is the epistomal suture. The face lacks tori in both bee and wasp.

The clypeal nodules of *Sericophorus* are not present in *Paracolletes*, although clypeal teeth are excessively developed in *Megachile*. The "teeth" of the wasp are adapted to the incision of the inner margin of the mandibulae, but there is no homologous structure on the mandibles of any bee. The facial foveae are reduced to mere dark marks in both insects. (Compare clypeus of *Anaeruceis clypeata*, sp. nov.)

The mouthparts of each conform to a primitive plan; the short broad glossa being deeply emarginate; the maxillary palpus having six equal segments, and the labial palpus four; mentum short and broad, and this, when added to the heavy stipes, gives an almost circular outline to the mouthparts; those of the bee are more slender. The lacinia is present in the wasps, but not in the bees, which have a larger galea. The salivarium is not so prominent in the wasps as in the bees, which use a copious secretion to weave silvery colloidal skin cells, but there is no evidence of a similar membranous substance in the cells of *Sericophorus*.

The thoraces have many features in common, but the wasp has the elevated horizontal dorsum of the epinotum, with many rugae, a character not prominent in *Paracolletes*, but very evident in many bees such as *Binghamiella* and *Halictus*. The horizontal dorsum is surely a primitive character. The mesophragma is somewhat similar in both genera.

The abdomen does not present any distinctive characters, for there are six visible segments in the females, and seven in the males, and both wasps and bees have a pygidial plate, that of the former bearing a number of stout spines. *Paracolletes* does not transport the bulk of the pollen on an abdominal scopa, but on the hind tibiae and femora.

The femora of the posterior legs are well developed in bees, but they are stout on the anterior legs of *Sericophorus*, for the posterior legs are the busiest for bees; the anterior pair do most of the excavating for the wasps.

In *Sericophorus* the legs are armed with numbers of stout spiculae, and rows of short nodes persist in fossorial bees such as *Euryglossa* and other archaic genera. The tarsi also are similarly armed, and one *Paracolletes* in the author's collection has unique long laminate lateral processes on the fore-tarsi. The hind basitarsi of female bees are usually short and broad; those of males slender; the latter form is elemental, and present in both sexes of the wasps.

Toothed claws, as in *Paracolletes*, are regarded by Michener (1944) as the more primitive, but those of *Sericophorus* are simple; the unequal hind calcariae of the wasp have a parallel in the bee *Goniocolletes* (Raym. 1935). There is no recognizable patella or knee-plate in Sericophorus, although it is prominent in Colletid bees. No fossorial bee possesses the excessively developed pulvillus of the wasps; the velum of the wasp's strigilis is narrow and serrate, and therefore nearer to that of ants than to *Paracolletes*.

The penis-valves of the genitalia in the wasps are free of the penis, but in the bees there is an intimate association. The curved sting of the female wasp is neither long nor particularly well developed, and the slender gonostyli are almost nude; the sting is weaker in *Paracolletes*.

The neuration of the wings in *Sericophorus* differs from that of *Paracolletes* in one important character; the first cubital cell receives the first recurrent nervure and the small second cubital cell is triangular; it is more nearly quadrate in *Paracolletes*. The large pterostigma may be regarded as a primitive character of the wasps, but it is inconspicuous in the bees; the hamuli are, on the average, fewer in the wasps. In two mutations of *Sericophorus* the second intercubitus nervure is obsolescent, thus leaving the insect with only two large cubital cells as in certain PARACOLLETINAE, e.g. *Lysicolletes* Raym., which also has spiculae on the tibiae.

A tendency to develop the high narrow third cubital cell of *Apis*, the hive-bee, is seen in such sphecids as *Tachytes* and *Notogonidea; Sericophorus* appears to link such genera with the lower wasps having subquadrate third cubitals.

The wings of the wasp and the bee are covered closely with fine hairs, but both lack the short stout alar-papillae present in the distal portion of wings of the higher bees such as *Anthophora* and *Bombus*. It is just possible to identify the vestiges of the alar-fenestrae in *Sericophorus;* they are more prominent in many bees, including certain *Halicti*, and *Binghamiella* especially.

It will be seen, then, that the gross morphology of wasp and bee has many affinities, and does not present any spectacular contrasts, hence the strong superficial likeness to the metallic-green bees *Paracolletes elegans* Sm. and *P. pictus* Raym.

A fundamental difference exists however in the diet of the larvae, if not of the adults, for while the young of the wasps is exclusively a meat-eater, the larva of the bee is vegetarian. The adults of both consume nectar –hydrocarbon, and pollen––nitrogenous protein, and it would appear that the substitution of pollen for meat in the diet of the young bee did not result in any loss of vigour, but rather an access of energy; the change increased the industry of the bees. The hunter has always been at a disadvantage when compared with the cultivator—even in the species *Homo*.

The choice of site, in sandy ground, and the building habits of the two insects are very similar, and the earth-works of one could easily be mistaken for those of the other, although the bees construct more extensive shafts.

The author has seen workers of the highest bees, *Apis* suddenly yield to the primitive instinct to excavate, and hundreds assembled to dig frenziedly in the damp soil at the bottom of a new post-hole.

The silk and pebble cocoons of the wasps are more substantial than the delicate membrane of the bees, but the oval cell is typical of both. Mutillids prey equally on the larvae of both insects.

The bees require twelve months for the completion of the life-cycle, and probably the number of progeny produced by the two females closely approximates. More than twelve months are required for the development of *Sericophorus* at low temperatures, but eleven months appear to be the normal period.

Since typical specimens of green *Sericophorus* are present in Tasmania, one postulates that the wasps reached the island before its separation from the mainland; the *S. reluceus* complex appears

to be more recent, since it has not yet been reported from the island. Colletid bees are well represented in Australia, and have many affinities with the insect-fauna of South America.

It would appear, from the evidence adduced, that the sericophorine wasps and the colletid bees are the ancient abutments of the bridge linking fossorial wasps and bees which reached Australia at some remote period, "when it was connected, or nearly connected, by land with other Continents, for the Colletidae . . . are perhaps as old as the Cretaceous." (Michener, 1944.)

There are six genera in the Subfamily SERICOPHORINAE; *Sericophorus* Sm.; *Helioryctes* Sm.; *Sphodrotes* Kohl.; *Zoyphium* Kohl.; and *Paranysson* Guerin, and these may be identified by the following comparisons. (See *Anacrucis,* gen. nov.)

Compared with *Sericophorus, Paranysson* is comprised of dull insects, coarsely and closely punctured, but not sericeous; face without tori; clypeal teeth adapted to mandibular notch as in *Sericophorus;* mandibles conspicuously excised on the outer margin; antennae subfiliform, apical segments acute, other segments not at all "knotted "(fast knotig erscheint); compound eyes converging above; anterior ocellus largest.

Prothorax larger; scutal and parapsidal furrows practically obsolete; abdomen larger than the thorax; metathorax smaller, with a semi-circular rugose area, and a small lateral tooth on some species; abdomen with truncated base, and without the spiny pygidial plate.

Legs slender, anterior tibiae without spines, but tarsal comb present; on the whole, the legs are not so conspicuously armed; the fifth tarsus and pulvillus small. Wings dark-fuliginous, second cubital cell small and petiolate, receiving the second recurrent nervure at its apical corner as in *Sericophorus;* first recurrent entering the first cubital cell; pterostigma moderately developed; hamuli numerous; posterior calcariae unequal.

Helioryctes conforms with the above diagnosis, and Arnold (1922), in his excellent Keys to the Ethiopean SPHECIDAE, gives the same characters for both genera. The specific description of *H. melanopyrus* (Gambia) would serve for *Paranysson helioryctoides* Turn. (Southern Rhodesia), and except for size, the very much larger *P. quadridentatus* Cam., (Victoria Falls); all have a black head and thorax, with ferruginous abdomen and legs, and dark wings, and resemble *Anacrucis ferruginea*, sp. nov.

It will be observed that these two genera are exceedingly close, but both differ sharply from *Sericophorus*, which includes a few species with ferruginous abdomen, and *Anacrucis*, which are almost entirely black.

The following characters distinguish the small wasps, 7 mm. approx. in length, in the genus *Heliorycles* Smith. The oval compound eyes converge on the vertex; antennae filiform, the apical segment acute; anterior clypeal margin not dentate; mandibles acute apically, and not toothed on the inner margin.

Pronotal collar well defined from above, and not appressed to the scutum as in *Sericophorus*.

Metathorax short and truncated, with the dorsum defined by a semi-circular ruga enclosing a reticulated area; there is a mucro laterally, at about the middle of the truncation.

Adomen larger than the thorax, and truncate at the base; apical segment carinate laterally; no pygidial plate.

Anterior legs have the tibiae unarmed, but the basitarsi have a slender comb; fifth tarsus and pulvillus not excessively developed as in *Sericophorus*.

The abdomen of *H. melanopygus* Sm. has a ferruginous abdomen after the manner of *Paranysson* species and the *bicolor* group of *Sericophorus*, but they are easily separated on the characters given above.

Kohl concluded that "in a narrow way", *Zoyphium* had some affinity with *Sericophorus=Tachyrrhostus*, consequently, there is a distant relationship to *Anacrucis*, which can easily be separated from Kohl's two Australian genera by certain characters which are included here for comparison.

Zoyphium[1] has lateral extensions of the prothoracic collar, and the second abdominal segment on the back, at both sides, is provided with a lateral tooth directed backwards (abdominis segmentum secundum dorsale utrinque dente retracto instructum).

It should be remembered that Kohl invariably referred to the metathorax, propodium or epinotum as the first abdominal segment, which is correct morphologically. The locality is given as Australia, and the male is unknown.

Williams (1919) gives a figure of the hooked femora of the male wasp, *Hyloliris mandibularis* Williams (LARRINAE). The remarkable structure is doubtless homologous with that found on Australian bees in the genus *Gonicolletes*, and is evidence in support of the contention that bees evolved from fossorial wasps.

1. Eine neue Hymenopterengatung Verh. k.k. Zool.,—bot. Ges. Wien, 43, p. 569—572, 1893.

Sphodrotes[2] is based on a male wasp coarsely punctured after the manner of *Paranysson,* with the well-developed genae giving the head a quadrate aspect. The anterior orbital margins are parallel, and the exterior margin of the mandibles deeply excised (mandibulae interdum margine exteriore profunde excisae). The second cubital cell is said to be petiolate. The locality is given as New South Wales, and the female is unknown.

The author has had no wasps conforming with the specific descriptions, and is forced to rely on the generic diagnoses for the above characters.

Notes on Anatomy

A female wasp, *S. teliferopodus* Raym., was taken at 5.20 a.m., on the 27th December, 1950, as she was about to descend her shaft. She did not bear any prey, and was probably returning after visiting the flowers of *Eucalyptus ficifolia,* which was then at the zenith of its inflorescence. She was dissected two hours later.

The largest organs of the flagellum are formed somewhat like a scoop standing vertically over a clear circle of light; there are miniature ones of similar form, and a number of dark leaf-like structures of medium size. No attempt could be made to study the functions of any.

The truncated stout setae of the glossa are bent at a right-angle, like a wall-bracket, and apparently would be of little service in spreading any colloidal secretion. Silken or membranous " cradle-gowns ", such as are woven by colletid bees, have not been observed.

The paraglossae of many species are close-set with stout setae exactly reproducing in miniature the pattern of the pygidium, Pl. 3, No. 8. The labial palpus of *S. viridis roddi* has the basal and apical segments longest and equal, the two others shorter and subequal. The basal segment is longest in *S. teliferopodus.*

There appeared to be only two ovarian tubules, each containing about fifteen eggs at various stages of development; two very large, and it was evident that these were ready for the two cells under construction; two a little smaller; six of half size; ten very small; ten minute.

Since three weeks approximately are required for the excavation of one shaft with its two cells, and the provisioning of them, and the active period limited to 21 weeks, it is more than probable that less than half the eggs are matured and utilized.

2. Neue Gattungen aus der Hymenopteren—Family der spheciden—Ann. k.k. Hofmus, Vien 4, p. 188–196, 1889.

Seven shafts, each having two cells, with twelve blowflies in each cell, appears to be the maximum effort that could be achieved by one wasp. If this be the case, then each female would require 168 male flies for the season.

The malpighian tubules are much more numerous than in halictine bees, for there appears to be about 50 in all—there are twelve or so in *Halictus;* and perhaps 100 in the hive-bee *Apis.*

The ventriculus is large, but not so well developed as it is in bees, for the " corrugated " aspect of the exterior is inconspicuous, and the walls appear to be thin and membranous. It contained a thin pasty amber-coloured substance, which was chiefly honey.

Rectal glands are prominent, and apparently formed like those of wild-bees, but none could be mounted for critical examination under the microscope.

The function of the 24 tiny urn-like organs along the anterior margin of the glossa could not be investigated, but one postulates, from their position and form, that they are probably organs of taste. Silk and other glandular secretions play little part in the physiology of the species.

Abdominal air-sacs are well-developed on each side dorsally of the abdomen, and the tracheae numerous, and in keeping with her powers of flight, while the wing-muscles are strongly developed.

There is not the close association of penis and valves in the genitalia that one sees in bees. The " claspers " are of specific value, and so are the serrations, but the genitalia must be mounted for critical study.

The pygidium of the males is broader, and the spines much finer than those of the females, but the apical sterna of the males possess characters of specific value. Since both sexes have only twelve segments in the flagellum, it is necessary to study the teeth and nodes of the clypeus; the males having only one tooth; the females two or three. This is a sex character.

The " strands " of the pulvillus are held together by numerous short curved transverse setae, but which nevertheless permit of a considerable lateral movement (see pl. I., No. 5).

Pore Organs

McIndoo (1914) claimed that the many groups of pore-organs which he found on various parts of the honey-bee were olfactory in function, but the experiments of other authors do not confirm his conclusions.

The present author has found most of McIndoo's groups of pore-organs on Australian wild-bees, and it would appear that many of them are present also in sericophorine wasps; there is little doubt that most are homologous with those of the bee.

There is a remarkable group of ten, in two rows of five, at the articulation of the trochanters of *S. relucens* Sm. (See pl. 6, No. 10.)

There are larger groups of pore-organs at the articulation of the coxae, and other groups are present on the bases of the wings. No attempt was made to identify all the groups, and their function could not be investigated.

Dr. W. H. Thorpe after surveying the remarkable experiments of Prof. K. von Frisch, concluded that the bee's ability to orientate itself is probably determined by the pull of gravity registered by the "proprioceptive" sense organs at the limb and abdominal articulations.—Nature, 2nd. July, 1949.

RELATIONSHIPS

By the character of the lateral rugae of the epinotum the sericophorine species may be grouped as follows:—

1. Blue, with fewer coarse short rugae, *S. chalybaeus; S. violaceus; S. minutus; S. cyanophilus; S. elegantior; S. spryi; S. claviger; S. gracillis; S. occidentalis.*
2. Greenish-blue, with more numerous finer rugae, *S. inornatus; S. sydneyi; S. rufipes; S. lilacinus; S. subviridis; S. victoriensis; S. littoralis.*
3. Green, with fewer coarser rugae, *S. teliferopodus; S. viridis* Sauss.
4. Bluish-green, with coarse rugae persisting over the dorsum, *S. cliffordi; S. patongensis; S. rugosus; S. metallescens; S. rufotibialis; S. niveifrons.* The bar of the cruciform incisure is hardly defined in this group.
5. Reddish abdomen, *S. bicolor; S. hackeri; S. castaneus; S. brisbanensis.*
6. Black species, *S. carinatus; S. relucens; S. rufobasalis; S. froggatti;* and *S. pescotti* approaches group 4, but *S. nigror* is distinct.

KEY TO SPECIES

Abdomen blue	1
Abdomen green	4
Abdomen ferruginous	15
Abdomen black	16
Scutellum red	17
Scutellum black	18

Large, shining, violet, femora and tibiae ferruginous 1

1. Two blunt nodes on clypeal margin, *S. violaceus* Raym. (Small. *S. spryi* Raym. falls here with one black clypeal node.)

Femora and tarsi blue, abdomen apically black 2

2. Three large nodes on anterior clypeal margin, *S. gracilis* Raym. (*S. elegantior* Raym. falls here, but is easily separated by the three small clypeal teeth, and entirely clear-ferruginous legs and antennae; also *S. niveifrons* Raym. with two clypeal teeth.)

Smaller, shining, peacock-blue with three clypeal nodes 3

3. All tibiae and tarsi piceous, *S. patongensis* Raym. (*S. rufo-tibialis* Raym. falls here with no clypeal teeth; *S. metallescens* Raym. metallic-green, with one stout node on anterior margin of clypeus; *S. tallongensis* Raym. with black head and one clypeal tooth, and *S. rugosus* Raym. which is smaller, with two clypeal teeth like the female of *S. Cliffordi* Raym.; the male of which has only one tooth.)

Abdomen apically, tibiae and tarsi all red 4

4. Angle of clypeus with a sharp tooth, *S. claviger* Kohl. (Subsp. *burnsiellus* Raym. falls here, with an excavated apical segment of the brown antennae; also *S. minutus* Raym., which is the smallest with a sharp clypeal angle.)

Large, entirely dull, green-blue 5

5. Clypeus with three large nodes, *S. chalybaeus* Sm.

Abdomen dull bluish-green, outer clypeal node largest of three 6

6. Scutellum green, with a black tubercle, *S. rufipes* Raym.

Scutellum black, with a larger tubercle, two outer clypeal nodes large .. 7

7. Metathorax shining blue, *S. subviridis* Raym.

Entirely shining green, abdomen with bronze and lilac tints 8

8. Clypeus, antennae, and femora all bright red, *S. viridis* (Sauss). (The subsp. *roddi* Raym. falls here, with the clypeus suffused laterally with bluish colour, femora red, but coxae and trochanters bluish.)

Larger, femora blue basally 9

9. Clypeus darker, with two prominent teeth, *S. teliferopodus* Raym. (Subsp. *okiellus* Raym. falls here, with many fine transverse rugae on the epinotum.)

Femora red, two teeth on clypeal margin, dull 10

10. Short peg-like spines on the pygidium, *S. victoriensis* Raym.

Femora and scapes greenish-blue 11

11. Clypeal margin with three nodular teeth, *S. chalybaeus* Sm. (*S. cyanophilus* Raym. falls here with brown tarsi and a rugose clypeus with three teeth; also *S. lilacinus* Raym. with smooth clypeus and three teeth; bright-ferruginous legs, and lilac lustre on abdomen. *S. littoralis* Raym. falls here, with two clypeal teeth, the outer one largest; antennae and tarsi ferruginous; head and thorax blackish-blue.)

Clypeal margin with three teeth, but long fine spines on pygidial plate .. 12

12. Third cubital cell not contracted at the top, *S. sydneyi* Raym.

Larger, with only trochanters and coxae blackish 13

13. Third cubital cell contracted at the top, *S. victoriensis* Raym.

Green, nervures of wings pale-amber 14

14. Hair of epinotum black tipped with white, *S. teliferopodus* Raym.

Small, clypeus blue, thorax blue 15

15. Abdomen entirely bright-ferruginous, *S. bicolor* Sm.

Large, black abdomen 16

16. Clypeus with ivory-coloured markings, *S. nigror* Raym.

Clypeus black, without a median carina 17

17. Small, with the scutella red, *S. reducens* Sm. (The subsp. *ruficornis* Raym. falls here, with ferruginous antennae. The subsp. *nigricornis* Raym. has black antennae. *S. rufobasalis* Raym. is much smaller, with the basal segment of the abdomen entirely red.)

Larger, clypeus with a median carina 18

18. Dorsum of propodium minus a sharp rim, *S. carinatus* Raym. By the serrated process of the genitalia, and the apical sternum of the male, the species *S. chalybaeus* Sm. is related to *S. violaceus* Raym. and *S. rufotibialis* Raym.

Dorsum bounded by a sharp rim 19

19. Scutellum black, abdomen long, *S. pescotti* Raym. There are two bands of ivory-colour on the black prothoracic collar of this species, and this instantly separates it from *S. relucens* Sm., which has the ivory bands on a red collar. (The smaller *S. froggatti* Raym. falls here with a short globose abdomen.)

SUPPLEMENTARY KEY

All very small species

Abdomen clear pale-ferruginous 1

1. Nervures and tegulae palest-amber, *S. bicolor* Sm.

Abdomen dark-castaneus 2

2. Clypeus with two nodular teeth, *S. castaneus* Raym.

Metathorax with "honey-comb" rugae 3

3. Clypeus with one tooth, *S. brisbanensis* Raym.

Metathorax without "honey-comb" rugae 4

4. Tegulae reddish, *S. hackeri* Raym.

Clypeus coarsely rugose 5

5. Wings with a brownish tint, *S. castaneus* Raym.

Clypeus with fine close punctures 6

6. Wings with a milky tint, *S. hackeri* Raym.

SPECIFIC DESCRIPTIONS

Sericophorus bicolor, Smith, stat. nov.

Female.—Length, 7 mm. approximately. Bluish-green, with apricot-coloured abdomen.

Head transverse, bluish or greenish; face with foveae reduced to small dark marks; frons sericeous, a low median rise; clypeus convex, blue, anterior margin ivory, with two minute nodular teeth; supraclypeal area not defined; vertex with short black hair; compound eyes reniform; genae with fine piliferous punctures; labrum reddish; mandibulae ivory-coloured, reddish apically; antennae entirely pale-amber or apricot-colour, with a black dot apically.

Prothorax from above shows as a fine blue line; tubercles brownish-blue; mesothorax bluish-green, with a sericeous sculpture, but it is brighter, and tending to become rugose, white hair; scutellum subtuberculate, closely punctate; postscutellum more closely punctate; metathorax coarsely rugose at the sides of the cruciform structure, considerable white hair; abdominal dorsal segments entirely pale-apricot colour; pygidial plate with long fine whitish spines, minute piliferous punctures; ventral segments more shining.

Legs same colour as abdomen, only the coxae are blue; the large pulvillus is black in strong contrast to the fifth tarsus; claws and hind calcar same colour as abdomen; tegulae apricot-colour; wings faintly yellowish, first recurrent far distant from the first intercubitus; nervures palest-amber; cells not normal for the genus, the third cubital almost quadrate; pterostigma small, pale-amber; hamuli eight or so.

Locality.—Cooper's Creek, Central Australia, leg. J. G. Reuther. Swan River, Western Australia, Coll. unknown.

Specimen in the collection of the South Australian Museum.

Allies: It is not certain that the Central Australian insect is conspecific with the western wasp. The Cooper's Creek specimen is of a beautiful purplish-blue, and on one wing a portion of the second recurrent is duplicated. This record greatly extends the range of this beautiful species (see No. 19, pl. 3).

Sericophorus brisbanensis, sp. nov.

Type, male.—Length 6 mm. approximately. Blue, with light castaneous abdomen.

Head with scanty white hair, finely punctured; frons with a median sulcus as in *castaneus;* clypeus with one tooth on convex anterior margin; supraclypeal area not defined, but punctation finer and closer; vertex practically nude; compound eyes with anterior margins parallel; genae nude; labrum ferruginous; glossa very much longer than in the *relucens* complex; mandibulae ferruginous, reddish apically; antennae with bluish scapes and castaneous flagella.

Prothorax with a line of white hair; tubercles blackish, with a line of white hair; mesothorax dull rich blue, large close punctures connected with short lines; scutellum shining, punctures not so close; postscutellum with closer smaller punctures; metathorax with coarse hexagonal rugae like honeycomb; a little white hair on dorsum, shaft of cruciform structure short and broad; abdominal dorsal segments of a lighter, brighter castaneous-red; posterior margins paler-amber; pygidial plate with long fine spines; ventral segments similar.

Legs blue, with ferruginous tibiae; tarsi ferruginous; anterior comb with four spines; claws red; hind calcar reddish; tegulae dull-amber, suffused with bluish; wings milky; nervures palest-amber; second recurrent very close to second intercubitus; cells; third cubital rather large; pterostigma very pale-amber.

Locality.—Brisbane, Queensland, 15th February, 1916, leg. H. Hacker.

Type in the collection of the Queensland Museum.

Allies: Looks just like *S. castaneus,* which has two clypeal teeth, but structure of metathorax very different.

Sericophorus carinatus, sp. nov.

Type, female.—Length 9.5 mm. approximately. Black, red legs.

Head transverse, clothed with dense ochreous appressed hair; face with a minute swelling, punctures contiguous; frons bears a minute carina; clypeus with the anterior margin polished, and two small nodular teeth; supraclypeal area with a raised median line or carina; on vertex foveae defined as lunate purple marks; compound eyes converging slightly above; genae with appressed white hair; labrum black; mandibulae black, spoonlike, not acute as in *relucens,* a median amber mark; antennae short, black, segments wider than long.

Prothorax red, with a wide ivory band; tubercles ferruginous; mesothorax excessively closely punctured, a spot of silvery hair laterally at the scutellar suture; scutellum and postscutellum red, closely punctured; metathorax lacks the large angular tooth laterally, and thus is close to *S. relucens;* abdominal dorsal segment one polished, scattered punctures, the appressed silvery hair of the abdomen so disposed that only alternative halves are seen, hind margins black (amber in *relucens*); ventral segments polished.

Legs red; tarsi darker; claws red; hind calcar very curved, amber; wings hyaline; the recurrent nervures at subequal distances from the intercubiti; cells; the small second cubital almost petiolate; pterostigma brown; hamuli eleven.

Locality.—Sandringham, Victoria, 21st February, 1950, leg. Rayment.

Type in the collection of the National Museum of Victoria.

Allies: Close to *S. reducens*, but larger, and separated by the spoonlike short mandibulae and the carina on the clypeus.

Sericophorus castaneus, sp. nov.

Type, female.—Length 6 mm. approximately. Blue, with reddish abdomen.

Head bluish, closely punctured; face in certain lights with much appressed white hair; frons with a median sulcus; clypeus rugose, anterior margin with two teeth, inner one largest; supraclypeal area depressed; vertex with white hair; compound eyes with anterior margins parallel; genae with considerable white hair, sericeous; labrum amber; mandibulae amber, darker, basally, red apically; antennae with bluish scapes; flagella missing on specimen.

Prothorax blue, with a line of white hair; tubercles blackish, with a fringe of white hair, mesothorax with close punctures of large size; scutellum similar, but more shining; postscutellum darker, with closer punctures, and white hair; metathorax more shining, with huge rugae (refer to plate); considerable white hair on dorsum; abdominal dorsal segments of a rich castaneous colour; hind margins amber; considerable white hair; pygidial plate with coarse spines of medium length; ventral segments similar, but with less hair.

Legs redder, femora, trochanters and coxae bluish; tarsi red; anterior tarsal comb with six long strong spines; claws red; hind calcar red; tegulae bluish basally, otherwise piceous; wings brownish; nervures pale-amber, second recurrent closer to second intercubitus; cells normal for the genus; pterostigma very pale, with amber margin.

Locality.—Brisbane, Queensland, 12th February, 1918, leg. H. Hacker.

Type in the collection of the Queensland Museum.

Allies: Close to *S. brisbanensis*, which has one clypeal tooth; these may be the two sexes.

Sericophorus chalybaeus Sm. stat. nov.

Ann. Mag. Nat. Hist., (2) VII., p. 32, 1851

Female.—Length 10 mm. approximately. Dull steely-blue, red legs.

Head transverse, sericeous; face with a few white hairs; frons without a distinct swelling; clypeus with the anterior margin slightly convex, with three small nodular teeth laterally, very coarse punctures; supraclypeal area not defined; vertex with ocelli set in small excavations, some black hair; compound eyes reniform, anterior margins practically parallel; genae clothed with silvery pile; labrum ferruginous; mandibulae ferruginous, margined and tipped with reddish-black; antennae with scapes and pedicel black, flagellum ferruginous, a black dot apically.

Prothorax shows as a fine line of white hair; tubercles bluish, with a fringe of white hair; mesothorax metallic-blue, sericeous, a few black hairs (in this genus the short medioscutal furrows are flanked on either side by shining short lines, and the position of the parapsidal "furrows" is indicated by raised lines); scutellum blacker, and sub-tuberculate; postscutellum with larger punctures; metathorax more bluish, dorsum of epinotum microscopically rugose, with six transverse carinae at sides below; abdominal dorsal segments with numerous piliferous punctures, pygidial plate dark, with long fine spines; ventral segments with a few black hairs.

Legs dull-reddish, the coxae, trochanters and femora basally bluish; tarsi red, anterior tarsal comb with six spines; claws red; hind calcar darker red; tegulae blackish-brown; wings subhyaline; nervures blackish, the first recurrent far distant from the first intercubitus; cells normal for the genus; pterostigma large, blackish; hamuli fourteen.

Locality. "New Holland" collector not known. Daylesford, Victoria, 23rd January, 1948, leg. "B.G." Wannon, Victoria, 11th January, 1948, leg. "B.G."

Females in the collections of A. N. Burns, Rayment, and male in National Museum, Melbourne.

A female, larger than the type, with the lateral carinae of the epinotum quite inconspicuous, and dorsum smoother, with many finer punctures; the striae are obsolete; the black tubercle of the scutellum is very conspicuous; apical third of the femora red. This may be separted when the male is known. Leura, Blue Mountains, New South Wales, 24th January, 1903, leg. W. W. Froggatt.

Two males taken with several females at the same time and place, and associated by the collector, is apparently the undescribed sex of *S. chalybaeus* Sm. It is only a trifle larger than the male of *S. cliffordi* Raym., and could easily be mistaken for it. It can, however, be distinguished by the following comparison:—

> *S. cliffordi* has considerable white hair on the face, and the tarsi are reddish throughout. *S. chalybaeus* has little or no white hair on the face, and it has black tarsi, with the fifth bright ferruginous in strong contrast.
>
> The third cubital cell is greatly contracted at the top in *S. cliffordi*, but hardly at all in *S. chalybaeus*. The author was fortunately able to study the genitalia of *chalybaeus*. Both sexes taken on flowers of *Leptospermum scoparium*.

Gorae West, Victoria, 27th December, 1951, leg. Clifford W. Beauglehole. Gorae West, Victoria, 9th January, 1952, leg. Clifford W. Beauglehole. Allotype in the collection of the National Museum of Victoria.

One of the wasps was on the ground, and close at hand was a prismatic-purple mutillid, which is probably parasitic on these wasps, for mutillids were taken by the author from shafts in Sandringham. (See pl. 6, Nos. 8 and 9 for details of genitalia.)

Gorae West, Victoria, 23rd December, 1950, A. Cliff. Beauglehole.

Allies: *S. sydneyi* Raym., which is a greener, slightly smaller species; *S. cliffordi* Raym., which is of the same colour, but a trifle smaller.

Smith says his specimen is unique in the collection of the British Museum.

Sericophorus chalybaeus fulleri, subsp. nov.

This female may be separated by the following characters, and is best described by comparison.

Subspecies.	*Species.*
Duller, rougher.	Brighter, smoother.
Slightly larger, robust.	Smaller, slender.
Ocelli larger.	Ocelli smaller.
Clypeal teeth larger, truncate.	Clypeal teeth smaller, acute.
Mandibles reddish.	Mandibles amber.
Anterior orbital margins parallel.	Slightly converging above.
Head wider.	Head narrower.
Mesothorax duller, punctures shallower.	Mesothorax brighter, punctures deeper.
Scutellum duller.	Scutellum brighter.
Tubercle compressed.	Tubercle mammiform.
Dorsum shining between larger punctures.	Dorsum duller between finer punctures.
Cruciform structure more defined.	Structure less defined, eight rugae laterally.
Punctures of abdomen not so close.	Punctures closer, and rougher between.
Tarsal comb of seven spines.	Tarsal comb of six spines.
First recurrent far distant.	Recurrents equidistant from intercubiti.
Wings lighter.	Wings darker.
Third cubital cell hardly narrower at top.	Third cubital cell somewhat contracted at top.

Locality.—Blundells, 20 miles west of Canberra, 19th January, 1936, leg. M. E. Fuller.

Type in collection Division of Entomology, C.S.I.R.O., Canberra, A.C.T.

Sericophorus claviger (Kohl.) stat. nov.

Ann. K. K. Hofmus, Wien, VII., pp. 197–234, 1892

Female.—Length, 7.5 mm. approximately. Greenish-blue.

Head transverse, with numerous large punctures; face with considerable white hair; frons with a swollen area, and a polished line that broadens as it approaches the ocellus; clypeus black, larger punctures, with the angles of the anterior margin produced to a low nodule; the margin straight between the nodules; supraclypeal area not defined; vertex longer than in other species; compound eyes converge a trifle at top; genae with numerous piliferous punctures and black hair; labrum ferruginous; manibulae ferruginous, dark-red apically; scapes dark; flagellum claviform, ferruginous in certain lights, the two apical segments black, the median segments produced to a node (fast knotig).

Prothoracic collar appears as a mere line; tubercles bluish; mesothorax with a sericeous sculpture, and black piliforous punctures; the scutellum and the postscutellum lack the sericeous sculpture, but are shining, with numerous large punctures (much closer on postscutellum); metathorax with the dorsum of the epinotum finely rugose; abdominal dorsal segments green, with numerous piliferous punctures, apical segments red, the large pygidial plate with fine spines; ventral segments polished.

Legs with coxae, trochanters, and femora basally bluish; tarsi red; claws red; hind calcar red, with darker tips; tegulae piceous; wings hyaline; cells normal for the genus; nervures amber, the distance between the first recurrent

and the first intercubitus is twice as long as the distance between the second recurrent and the second intercubitus; pterostigma amber, with a dark-brown margin; hamuli eleven.

Allies: Kohl stated that claviger stands next to *chalybaeus,* Sm., but it is not very close, and is nearer to species such as *spryi,* which is about the same size; *chalybaeus* is a much larger duller insect of an even steely-blue colour. It is probable that the type insect is a male.

A female, not typical, with the anterior margin of the clypeus not straight as in the species, the head only obscurely metallic, and the clypeus shining black.

Locality.—Lane Cove, New South Wales, 25th March, 1934, leg. Norman W. Rodd.

A female, not typical, having dark-brown antennae with black only on apical segment, which is differently shaped.

Locality.—Woollahra, Sydney, New South Wales, 2nd April, 1939, leg. Alex. Holmes.

Taken on flowers of *Kunzia ambigua.*

Two males, typical.

Locality.—Darnum, Gippsland, Victoria, January, 1913, leg. Chas. Oke. Mt. Victoria, New South Wales, 3rd January, 1931, leg. A. N. Burns.

A male, larger, 8.5 mm., with the apical segments of the abdomen red, and the fine rugosity laterally on the dorsum very conspicuous, as is the tubercle on the scutellum. Clypeal punctures in *claviger* are much coarser, almost rugose, head black, the dark apical segments of the antennae are not comprissed.

Locality.—Sydney, New South Wales, 8th December, 1918, leg. G. H. Hardy.

Sericophorus claviger burnsiellus, subsp. nov.

Type, male.—This form differs from the species by the black flagellum, the remarkable apical segment of which is compressed laterally (see No. 3, Fig. 2) the mandibles are very dark, and the apical segments of the abdomen black (red in the species); scutellum subtuberculate. When the female is known the subspecies will almost certainly be given specific rank.

Locality.—Chelsea, Victoria, 26th October, 1918, leg. L. Treblecock.

A slightly larger male, with apical segment of flagellum excavated; clypeus with the tooth larger and somewhat hooked; apical segments of abdomen black; five spines on anterior tarsal comb; second recurrent very close to second intercubitus; nervures amber; hamuli eleven.

Locality.—Cavendish, Victoria, 8th January, 1948, leg. "B.G."

A larger male, with apex of abdomen black, apex of flagellum excavated.

Locality.—Lilydale, Victoria, probably collected by the late Frank Spry.

Sericophorus cliffordi, sp. nov.

Type, female.—Length 9 mm. approximately. Dark-blue, red tibiae.

Head sericeous, with considerable silvery hair on lower part of face; many piliferous punctures; frons with a low swelling, and a short fine sulcus; clypeus black, shining, median punctures largest, three clypeal teeth, including that of the angle; vertex with black hairs tipped with white; compound eyes have the anterior margins practically parallel; genae sericeous, with white hair; labrum black; mandibulae shining black, with obscure reddish tint; antennae ferruginous beneath, the three basal segments and modified apical one blackish.

Prothorax much appressed, with silvery hair laterally; tubercles black, small, with a fringe of white hair; mesothorax sericeous, with many piliferous punctures, the black hairs somewhat hooked, with white tips; scutellum subtuberculate, almost black, and very shining, black hair; postscutellum bluer, with closer smaller punctures; metathorax with the stem of the cruciform structure much expanded at base; the dorsum finely rugosopunctate; laterally, about six fine carinae; abdominal dorsal segments sericeous, a dusting of fine white hair; microscopic piliferous punctures; pygidial plate black, with numerous coarse spines; the basal tergum is the widest; ventral segments smoother.

Legs blue-black, femora distally, and tibiae ferruginous-red; tarsi suffused with blackish, except large fifth, which is ferruginous; claws reddish; hind calcariae red; tegulae shining piceous; wings hyaline; nervures blackish-brown, first recurrent farther from the first intercubitus; cells; third cubital hardly contracted at top; pterostigma blackish-brown; hamuli eleven.

Allotype, male.—Length, 6.5 mm. approximately. Dark-blue.

Head sericeous, with numerous piliferous punctures; face with a few white hairs; frons practically without a swelling, but with a fine median sulcus; clypeus black, closely punctured, angle developed to a small triangular tooth; vertex with black hair; compound eyes have anterior margins practically parallel; genae sericeous, with a few silvery hairs; labrum black; mandibulae black, with obscure amber tint; antennae black, slightly modified on apical segments.

Prothorax appressed, a few white hairs laterally; tubercles black; mesothorax scutellum and postscutellum as in the female; metathorax with the dorsum defined by a semicircular ruga; on the whole, the epinotum is more coarsely rugose; abdominal dorsal segments as in the female, the pygidial plate is more rounded, and broader than that of the female, with finer spines; ventral segments more polished.

Legs blue, tibiae bright ferruginous-red; tarsal comb of five spines; tarsi as in female; claws red; hind calcar red; tegulae shining black; wings as in female; hamuli eleven.

Locality.—Gorae West, Victoria, 16th January, 1951, leg. Cliff. Beauglehole. A male, 9th January, 1952, leg. Cliff Beauglehole.

Type and allotype in the collection of the National Museum of Victoria.

Allies: *S. rufotibialis* Raym. is very close, but that male has a red pygidial plate; lacks clypeal teeth, has red mandibulae, and black flagella. It is a larger insect. *S. cliffordi* males, taken at same time and place as males of *S. chalybaeus*, have red femora; *chalybaeus* has blue-black femora.

Although the sexes were not taken in cop, there are the sex differences in the structure of the clypeal teeth and there is little doubt that the sexes are correctly associated. The large serrated process of the genitalia is very distinctive.

One female on *Eucalyptus Kitsoniana*, but both sexes were taken on flowers of *Leptospermum scoparium*. The collector sent the following note—" They have an extremely short stay on the flowers; do what they came for, and quickly disappear."

Sericophorus cyanophilus, sp. nov.

Type, female.—Length, 10 mm. approximately. Bluish-violet, with red legs.

Head transverse, sericeous; face with a few black hairs tipped with white; frons with a short carina; clypeus black, shining, rugose-punctate, anterior margin with three teeth, the outer one very large; supraclypeal area not defined,

but punctures smaller; vertex with ocelli in shallow smooth depressions; compound eyes with anterior margins practically parallel; genae with minute piliferous punctures, and a few white hairs; labrum blackish; mandibulae amber, reddish-black apically; antennae with bluish scapes, pedicel and first segment of flagellum dark-brown.

Prothorax rather stout, with a line of white hair; tubercles blackish, with smoky hair; mesothorax roughly sericeous, the black hair with white curved tips; scutellum black, more shining, with a low mammiform tubercle; postscutellum shining, closer punctures not smaller; metathorax more violet, with about eight fine carinae laterally, and rugosopunctate with a few white hairs; abdominal dorsal segments violet, with a dusting of white hair, pygidial plate brown, with numerous coarse long spines; ventral segments more shining.

Legs blue, tibiae and knees ferruginous; tarsi brown, fifth ferruginous; anterior comb with seven long strong spines; claws reddish; hind calcar reddish; tegulae piceous; wings subhyaline; nervures sepia, strong, the second recurrent much nearer the second intercubitus; cells normal for the genus; pterostigma amber, with a darker margin; hamuli fourteen of pallid colour.

Locality.—Stanthorpe, Queensland, 4th November, 1914, leg. unknown.

Type in the collection of the Queensland Museum.

Allies: Close to *S. violaceus*, Raym. which is smaller, with ferruginous clypeus, scapes and legs; falls next to *S. lilacinus*, Raym. Compared with *S. chalybaeus* this female has much more white hair on the abdomen, and is larger.

Sericophorus elegantior, sp. nov.

Type, female.—Length 7 mm. approximately. Blue, green abdomen.

Head transverse, bright, almost blackish-green, hair tipped with white; face with a mammiform swelling; frons with a fine carina; clypeus entirely ferruginous, with two large and one small nodular teeth; supraclypeal area not defined; vertex with a little black hair; compound eyes hardly converging above; genae with much white pile; labrum ferruginous; mandibulae ferruginous, with dark-red tips; antennae entirely ferruginous, a black spot on the excavated apical segment.

Prothoracic collar shows as a blackish line, white hair laterally; tubercles blackish, a white fringe of hair; mesothorax bright, subsericeous, purplish-blue, many pilferous punctures, some black hair; scutellum tuberculate, much black hair; postscutellum more closely punctured; metathorax with dorsum of epinotum more rugose, much white hair laterally; abdominal dorsal segments chalybeous, hind margins emerald-green except on one, some ochreous hair, red pygidial plate with many long fine spines; ventral segments polished, with a few golden hairs.

Legs entirely clear light-ferruginous; tarsi similar, anterior tarsal comb with five slender spines; claws pale-ferruginous; hind calcar pale-amber; tegulae amber; wings slightly milky; nervures brown, first recurrent far distant from first intercubitus; third cubital cell contracted at top; pterostigma amber, with a darker margin.

Locality.—Bolgart, Western Australia, March, 1951, leg. Rica Erickson.

Paratype.—Not known, but probably New South Wales, leg. A. N. Burns.

Type in the collection of the National Museum of Victoria; paratype in the collection of A. N. Burns.

Allies: Resembles a very small *S. rufipes* by the clear legs and antennae, but is nearer *S. spryi*, which has dark antennae. It is a handsome though small wasp.

Sericophorus froggatti, sp. nov.

Type, female.—Length, 5.5 mm. approximately. Black.

Head transverse, with an obscure aeneas lustre; face on anterior half with dense silvery appressed hair; frons so excessively densely punctured as to appear granular; clypeus black, with two small nodular teeth (not including the angle); supraclypeal area not defined, and lacking a carina and swelling; vertex long, closely punctured, almost nude; compound eyes converge slightly above; genae with close fine piliferous punctures, and short white hair; labrum amber (insect is carded, and clypeus, &c., difficult to examine); mandibulae ivory-coloured, reddish-amber apically; antennae rather short, submoniliform, black, the apical segments slightly reddish beneath, and tip compressed.

Prothorax black, not closely appressed, with the ivory interrupted line expanded laterally, a few white hairs; tubercles largely ivory-coloured; mesothorax black, bright, with close piliferous punctures of medium size, a few appressed white hairs; scutellum and postscutellum similar; metathorax all black, with a long enclosed area and a fine median carina, the dorsum is finely rugosopunctate, some white hair laterally; terga black, bright, with fine piliferous punctures, and a dusting of appressed silvery hair, two, three, and four with pallid margins; caudal plate black, with thick short black spines; ventral segments black, with white hair.

Legs ferruginous-red, an ivory-coloured spot distally on anterior and median femora, coxae and trochanters blackish; tarsi red; pulvillus small and black; hind calcar straw-colour; tegulae palest-amber; wings hyaline; nervures amber, recurrents far distant from the intercubiti; small second cubital forming almost an equilateral triangle; pterostigma amber; hamuli nine, pallid.

Locality.—Mittagong, N.S.W., 12th January, 1902, leg. W. W. Froggatt.

Type in the collection Department of Agriculture, New South Wales.

Allies: The enclosed area of dorsum resembles that of the larger *S. pescotti* Raym., but it is definitely distinct. These two species could almost be included in *Anacrucis* but for the enclosure.

Sericophorus gracilis, sp. nov.

Type, female.—Length, 9 mm. approximately. Dull-blue.

Head sericeous, transverse, with a sprinkling of white hair; frons with a fine carina that reaches the median ocellus; clypeus black, prominent, closely punctured, anterior half rugose with three teeth; (supraclypeal area is not defined in the genus); vertex with some black and white hair intermixed; compound eyes reniform; genae with a few white hairs; labrum black; mandibulae dark-red, black basally; antennae with scape and pedicel black, flagellum rufous, apical segment black.

Prothorax not so appressed as in *teliferopodus;* tubercles blackish, with a fringe of white hair; mesothorax slightly greener; scutellum blackish-blue, punctures larger and wider apart; sub-tuberculate; postscutellum with closer punctures; metathorax more purple, shining, a number of transverse carinae laterally; abdomen very slender apically; abdominal dorsal segments purple, shining, with some white hair laterally; pygidial plate black, entirely covered with long fine spines; ventral segments more shining.

Legs blue, tibiae ferruginous; tarsi dark-blue or black, only fifth ferruginous, anterior armed with a comb of coarse spines as in other species; claws red; hind calcar red basally, black apically; tegulae shining piceous; wings hyaline;

nervures light-brown, first recurrent far short of the first intercubitus; cells; third cubital hardly contracted at the top; pterostigma brown, margined with black; hamuli about eleven.

Locality.—Glen Aplin, Queensland, 11th December, 1945, leg. "A.G."

Type in the collection of A. N. Burns.

Allies: Easily known from all others by its slender form; *chalybaeus* is not close, except in colour.

Sericophorus hackeri, sp. nov.

Type, male.—Length 5 mm. approximately. Blue, with red abdomen.

Head closely and finely punctate; face with white hair on lower part; frons with a small mammiform swelling; clypeus very finely punctate; with angle of convex margin produced to a small sharp tooth; supraclypeal area not defined; vertex without much hair, and no depressions; compound eyes with anterior margins parallel; genae practically nude, closely punctured; labrum dark-red; mandibulae dark-red; antennae with bluish scapes and pedidel, flagellum ferruginous.

Prothorax with little hair; tubercles blackish; mesothorax with finer punctures than in *castaneus*, but rougher, almost rugoso-punctate; scutellum similar; postscutellum with smaller closer punctures; metathorax rugose, but lacking the hexagonal "honey-comb" of brisbanensis; abdominal dorsal segments dull-castaneous, with brownish suffusions; a few fine white hairs, pygidial plate paler, with a few long fine spines; ventral segments similar.

Legs blue, tibiae ferruginous; tarsi ferruginous; anterior comb with four spines; claws ferruginous; hind calcar reddish; tegulae pallid; wings with a milky shade; nervures palest-amber, the second recurrent is very close to the second intercubitus, and has a short spur parallel to the cubitus nervure; cells normal; pterostigma pallid, with amber margin.

Locality.—Brisbane, Queensland, 8th February, 1916, leg. H. Hacker.

Type in the collection of the Queensland Museum.

Allies: Close to *S. brisbanensis* and *castaneus*, but sculpture of metathorax very different.

Sericophorus inornatus, sp. nov.

Type, female.—Length, 9 mm. approximately. Bluish with obscure green lustre.

Head transverse, with a green tint, rather smooth, dull sericeous; frons with a few white hairs on anterior portion and a low mammiform rise; clypeus sculptured like the frons, with two large teeth on anterior margin; supraclypeal area similar to the smooth sericeous sculpture of the frons; vertex with a few black hairs; compound eyes converging on the vertex; genae very finely sericeous, with a few white hairs at base; labrum dark-brown, mandibulae amber, dark-red apically; antennae with scapes and pedicel dark, flagellum ferruginous, but apically it shades to dark-brown and black.

Prothorax thicker than in other specimens, with white hair laterally; tubercles black; pleura with blackish hair; mesothorax dull-blue, sericeous, with inconspicuous piliferous punctures, and a few black hairs; scutellum much brighter, with large punctures, and a sharp black tubercle; postscutellum greener, and more shining; metathorax with a greenish tint, and fine transverse rugae very inconspicuous, so that it is minus the coarse rugae of all the other species;

abdominal dorsal segments bluish, and brighter, one produced to a tubercle dorsally, large truncated pygidial plate with short coarse spines; ventral segments polished.

Legs blue, tibiae ferruginous; tarsi ferruginous; claws ferruginous; hind calcar reddish; tegulae dull-piceous; wings hyaline; nervures sepia; cells normal for the genus; pterostigma sepia, with darker margin; hamuli thirteen.

Locality. Wynyard, Queensland, 1st February, 1916, leg. G. H. Hardy.

Type in the collection of the Queensland Museum.

Allies: Small forms will be mistaken for *S. claviger*, Kohl., which has only one tooth at the sharp clypeal angle.

Known by the inconspicuous rugae of the metathorax.

Sericophorus lilacinus, sp. nov.

Type, female. Length, 10 mm. approximately. Bluish-violet, red legs.

Head transverse, obscure greenish, sericeous, with white hair; face with no black hair; frons with a mammiform tubercle; clypeus blackish, finely punctured, with much white hair, and three large black teeth; supraclypeal area not defined; vertex with foveae not evident; compound eyes converge only on vertex; genae finely sericeous, with much white hair; labrum reddish-black; mandibulae amber, darker basally and apically; antennae with scape and pedicel brown, flagellum ferruginous.

Prothorax bluish-violet, some white hair laterally; tubercles reddish, with a fringe of white hair; mesothorax very dull-sericeous, but bluer than head, shallow piliferous punctures, and some black hair; scutellum brighter, with an acute black tubercle; postscutellum with closer punctures; metathorax bluer, more shining, with very fine rugae laterally, and some white hair; abdominal dorsal segments shining, with minute piliferous punctures, and a dusting of white hair; pygidial plate brown, with long coarse spines; ventral segments blacker, and polished.

Legs ferruginous, coxae and trochanters blue; tarsi ferruginous, anterior comb with six long coarse spines; claws ferruginous; hind calcar ferruginous; tegulae amber, suffused with blackish; wings subhyaline, yellowish; nervures sepia; cells normal for the genus; pterostigma sepia with darker margin; hamuli eleven.

Locality.—Wynyard, Queensland, 1st February, 1916–17, leg. G. H. Hardy.

Type in the collection of the Queensland Museum.

Allies: Very close to *S. violaceus*, which has a ferruginous clypeus; *S. chalybaeus* Sm., which has blue femora. Annectant between *S. cyanophilus* and *S. violaceus*.

Sericophorus littoralis, sp. nov.

Type, female.—Length, 11 mm. approximately. Dull blackish-blue, red legs.

Head blackish, oily-bright, short white hair, microscopically tessellate, closely punctured; frons with a high compressed tubercle; clypeus closely punctured, convex, shining, anterior margin with two nodular teeth, outer one largest (see pl. 6, No. 15); compound eyes converging above; antennae entirely ferruginous except the black apical segment, which is formed like that at pl. 3, No. 11.

Prothorax with white hair; mesothorax blackish, granular, close shallow punctures, a few short black and white hairs; scutellum blackish, shining, tuberculate, with much larger punctures; postscutellum with smaller punctures; and white hair; epinotum with fine rugae laterally; the dorsum has very fine punctures on a minute tessellation.

Abdomen dull-bluish, white hair, margins very narrowly smoother, pygidium dark-reddish, with long pale spines; legs clear ferruginous, a little blackish on coxae; tarsi ferruginous, pulvillus large; tarsal comb of seven spines; wings slightly yellowish; nervures pale-amber, second intercubitus close to second recurrent; pterostigma amber, with a darker margin; tegulae dark-amber; tubercles reddish.

Locality: Ardrossan, South Australia, 27th November, 1885, leg. Tepper.

Type in the collection of South Australian Museum.

Taken at the base of the cliffs, St. Vincent Gulf.

Allies: Close to *S. sydneyi* Raym., but easily separated by the black nervures. *Sydneyi* has a blue-green head; blackish pygidial plate, and numerous fine striae on the epinotum; approaches *S. chalybaeus*, Sm. which is duller, with greenish-blue head, and greenish-black scapes; three clypeal teeth. *S. viridis* Sauss. is much brighter, and greener, with coppery tints on the abdomen.

Sericophorus metallescens, sp. nov.

Type, male.—Length, 6 mm. approximately. Greenish-blue.

Head sericeous, almost circular from the front; face on lower part with much white hair; frons with a fine black line, and a mammiform swelling; clypeus blackish, with many fine punctures, the angle produced to a large node which appears to be two nodules conjoined; supraclypeal area not defined; vertex with the ocelli placed more or less in excavations; foveae reduced to two blackish marks; compound eyes converging strongly above; genae microscopically lineate and punctate, with some white hair; labrum blackish; mandibulae reddish-amber, blackish basally and apically; antennae blackish; obscurely brownish beneath.

Prothorax thin, but not so appressed as in other species; tubercles blackish; mesothorax dull-metallic, sericeous, with minute punctures; scutellum much more shining, with larger punctures; postscutellum not quite so bright; metathorax shining, with many transverse and oblique coarse rugae, which it is impossible to describe intelligibly; abdominal dorsal segments shining, bluish-green, with many minute piliferous punctures; pygidial plate blackish, with numerous fine spines; ventral segments more polished, some coarse pale spines apically.

Legs with coxae, trochanters and femora metallic peacock-blue; tibiae amber, more or less suffused with blackish; tarsi piceous, with four coarse spines on the short anterior basitarsus; claws blackish-red; hind calcar blackish-red; tegulae piceous; wings hyaline; nervures brownish, the recurrents equally distant from the intercubiti; cells normal for the genus; pterostigma brown, with darker margin; hamuli nine.

Locality.—Fraser Park, New South Wales, 16th December, 1947, leg. Norman W. Rodd.

Type in the collection of the National Museum of Victoria.

Allies: Approaches *S. patongensis*, Raym., by the structure of the metathorax, and its brighter colour, with three clypeal teeth. It is closest to *S. rugosus*, which has red tibiae and is larger.

Sericophorus minutus, sp. nov.

Type, male.—Length, 5 mm. approximately. Royal-blue, with red legs.

Head transverse, shining, with minute piliferous punctures; face with appressed white hair; frons with a low swelling, and a fine line reaching the median ocellus; clypeus shining black, finely punctured, only the angle developed to an acute corner; supraclypeal area not defined; vertex elevated, with white hair; compound eyes hardly converging above; genae with minute piliferous punctures; labrum amber; mandibulae bluish, amber apically; antennae with black scapes, flagellum ferruginous beneath, apical segment and pedicel black, median segments above suffused with brown, and gradually broadening.

Prothoracic collar closely appressed in the middle; tubercles blackish; pleura sculptured like the mesothorax; mesothorax microscopically tessellate, shining, with close minute piliferous punctures and white hair; scutellum similar; postscutellum darker, not quite so blue; metathorax darker-blue, shining, dorsum defined by a fine ruga enclosing a rugose reticulation, some white hair laterally, the cruciform structure shining black; a fine rim laterally; abdominal dorsal segments with microscopic piliferous punctures, a light dusting of white hair, the posterior margins broadly amber, the broad pygidial plate blackish, with a few pallid spines; ventral segments more polished.

Legs ferruginous, coxae, trochanters, and anterior femora blue; tarsi orange-ferruginous; anterior comb of five pallid spines; claws ferruginous, pulvillus black; hind calcar pallid; tegulae amber, bluish apically; wings conspicuously milky, very iridescent, with white hair; nervures palest-amber, recurrents equally distant from the intercubiti; cells; second cubital triangular, third cubital not contracted at top, pterostigma pallid, with an amber margin; hamuli six or seven.

Locality.—Twenty miles south-east of Bourke, New South Wales, 27th October, 1949, leg. E. F. Riek.

Type in the collection of the Division of Entomology, C.S.I.R.O., Canberra, A.C.T.

Allies: *S. claviger* by the clypeal teeth; *S. rugosus* by the rugose dorsum; but easily separated by its small size, colour and milky wings. A very beautiful species.

Sericophorus nigror, sp. nov.

Type, female.—Length, 9 mm. approximately. Black, ivory markings.

Head transverse, closely punctured, a sprinkling of white hair; face with a large mammiform tubercle; frons closely punctured; clypeus with four ivory-coloured patches, and a median high longitudinal carina, much appressed silvery hair, anterior margin with three nodular teeth; vertex closely punctured; compound eyes converging above; genae closely punctate, with white hair; labrum blackish-red; mandibulae ivory, black tipped; antennae black, scapes short and stout; flagellum with a reddish tint in some lights.

Prothorax black, with two ivory lines on a bracket-shaped upper margin; tubercles ivory-coloured; mesothorax black, shining, closely punctate, not sericeous; scutellum similar; postscutellum more closely punctured; metathorax closely diagonally rugoso-punctate at sides of the cruciform structure, some white hair at base; abdominal dorsal segments black, closely punctate, hind margins broadly depressed, pygidial plate brown, with short fine spines; ventral segments polished, with brown margins.

Legs blackish to piceous, tibiae with an ivory stripe; tarsi brownish, anterior with a comb of coarse spines; claws ivory, with red tips, simple; hind calcar pale-amber; tegulae brown, with an ivory spot; wings subhyaline; nervures with

with the two recurrents equally distant from the intercubiti, so that the triangular small second cubital receives the second recurrent at about its middle; cells normal for the genus, a small appendiculate cell; pterostigma and nervures light-brown; hamuli fourteen.

Locality.—Lucindale, South Australia, 28th February, 1911, leg. Fr. Seeker.

Type in the collection of the South Australian Museum.

Allies: Not close to any described species, but approaches *S. relucens* Sm. by the ivory markings; easily known by the large frontal swelling and black colour.

Sericophorus niveifrons, sp. nov.

Type, female.—Length, 7 mm. approximately. Blue, with red legs.

Head blackish, shining, closely punctured; face with much silvery hair; frons with a low mammiform swelling, and a fine line that reaches the median ocellus; clypeus with a large red median mark, closely punctured, rugose anteriorly; anterior margin with two small teeth; supraclypeal area not defined; vertex with a few white hairs; compound eyes converging slightly above; genae with microscopic punctures and much white hair; labrum red; mandibulae ferruginous, darker apically; antennae orange-ferruginous, sub-clavate.

Prothoracic collar thicker laterally; tubercles blackish, with a fringe of white hair; mesothorax smooth, shining, closely punctured, with white hair; scutellum and postscutellum similar; metathorax with dorsum smooth, microscopic piliferous punctures, a few white hairs, the dusting of white hair is more evident along the scutellar suture; cruciform structure deep, shining, about eight short coarse rugae laterally; abdominal dorsal segments more finely punctured than the mesothorax, pygidial plate brown, with long fine spines; ventral segments more polished.

Legs ferruginous-red, only the coxae and trochanters blue; tarsi red, anterior comb of six spines; claws ferruginous; hind calcar ferruginous; tegulae bright, yellowish-amber; wings slightly milky, with white hair; nervures palest-amber, first recurrent far distant from first intercubitus; cells normal for the genus; pterostigma pale-amber, with a darker margin; hamuli nine.

Locality.—Five miles north of Nocatunga, Queensland, 13th November, 1949, leg. E. F. Riek.

Type in the collection of the Division of Entomology, C.S.I.R.O., Canberra, A.C.T.

Allies: *S. elegantior*, which is larger, with much coppery hair apically on the abdomen, and coarse punctures on dorsum of metathorax. A beautiful species.

Sericophorus occidentalis, sp. nov.

Type, female.—Length, 10 mm. approximately. Purple, light-ferruginous legs.

Head black, tessellate, with close punctures; face with sparce white hair; frons with a large compressed tubercle; clypeus clear-ferruginous, closely punctured, with two large teeth on anterior margin; supraclypeal area depressed; vertex shining, with considerable white hair; compound eyes with anterior margins parallel; genae very finely punctured, with a few white hairs; labrum and mandibulae clear-ferruginous, the latter with dark-red tips; antennae clear-ferruginous, rather short.

Prothorax deeply impressed, some white hair laterally; tubercles black, with smoky hair; mesothorax finely tessellate, numerous punctures of medium size, a few short black hairs; scutellum purple (black in *S. violaceus* Raym.), with a large tubercle; postscutellum brighter, with a greenish tinge, closer punctures; metathorax more irridescent purple, dorsum smooth between the smaller punctures, shaft of the cruciform structure very wide, six large lateral carinae, and white hair; abdominal dorsal segments with a cerise lustre, closely and finely punctured, hind margins depressed and reddish-amber, white hair, apical segments clear-ferruginous, together with the pygidial plate; ventral segments similar (darker in *S. violaceus*).

Legs entirely clear-ferruginous; tarsi clear-ferruginous, anterior comb of seven spines; claws ferruginous; pulvillus not very large; hind calcar ferruginous; tegulae amber; wings hyaline; nervures sepia, first recurrent far distant from the first intercubitus; cells normal for the genus; pterostigma amber, with dark margin; hamuli strong, eleven.

Locality.—Narrogin, Western Australia, leg. A. M. Douglas.

Type in the collection of the Western Australian Museum.

Allies: Very close to *S. violaceus* Raym., which is more shining, less hairy, and bluer, with larger punctures on the dorsum of the metathorax; posterior margins of terga not lighter. A series of nine females showing no variation.

Sericophorus patongensis, sp. nov.

Type, female.—Length, 8 mm. approximately. Bluish-green.

Head transverse, with much white hair, sericeous, face shining; frons with a swelling, and a long carina; clypeus green, closely punctured, with three large black teeth; supraclypeal area not defined; vertex depressed around the ocelli; compound eyes converge above; genae with much white hair; labrum brownish; mandibulae ferruginous, with dark-red tips; antennae submoniliform, brownish, with ferruginous tints in certain lights; apical segment with a compressed area.

Prothorax greenish-blue, not excessively appressed, some white hair; tubercles blue, with white hair; mesothorax of a beautiful lustrous peacock-blue, sericeous, some white hair; scutellum similar, but with black hair; postscutellum with white hair; metathorax of the same beautiful blue, a few punctures, and many large rugae (see fig. 3, No. 6); abdominal dorsal segments duller and greener, but very smooth, with fine piliferous punctures, a dusting of white hair, pygidial plate brown, with fine long pallid spines; ventral segments polished.

Legs lustrous metallic-blue, tibiae brown, anterior with a ferruginous stripe; tarsi brownish, fifth and pulvillus large, anterior comb with six spines; claws brown; hind calcar long and brown; tegulae blackish, dull; wings hyaline; nervures brown; cells normal for the genus; pterostigma brown; humuli ten.

Locality.—Patonga, New South Wales, 9th March, 1941, leg. Norman W. Rodd.

Type in the collection of Norman Rodd.

Allies: *S. rugosus* and *S. metallescens,* but the insect had a superficial resemblance to *S. spryi* and *S. claviger.*

Sericophorus pescotti, sp. nov.

Type, female.—Length, 7 mm. approximately. Black, red legs.

Head transverse, densely covered with appressed scale-like straw-coloured hair, with many fine white curved white hairs rising above it; frons with a carina joining clypeus and median ocellus; clypeus with the anterior margin bracket-shaped with two small nodular teeth; supraclypeal area not

defined; vertex comparatively long, microscopically finely rugoso-punctate; compound eyes converging slightly above; genae with the close-set appressed hair of the face; labrum black; facial foveae reduced to blackish-purple marks; mandibulae ivory to amber, dark-red apically; antennae black, segments broader than long, a reddish shade beneath.

Prothoracic collar with two ivory bands and some white hair; tubercles ivory, with a fringe of white hair; mesothorax has the large punctures almost contiguous; scutellum and postscutellum sculptured like the mesothorax; metathorax with the dorsum margined with a fine sharp rim, the enclosed area rugose, the cruciform incisure reduced to a circular pit, laterally the epinotum is margined with another sharp carina; abdominal dorsal segments black, with close piliferous punctures, and much appressed white hair, pygidial plate black, with numerous short stout spines; ventral segments polished black.

Legs dull-red, anterior and median femora with an ivory mark distally; tarsi red; claws dark-red; hind calcar amber; tegulae reddish-amber, with an ivory spot; wings hyaline; brown nervures typical for the genus, the recurrents equally distant from the intercubiti; cells normal; pterostigma dark-brown.

Type, locality. Sandringham, Victoria, 21st February, 1950, leg. Rayment. One female. Brisbane, Queensland, 8th February, 1916, leg. H. Hacker.

Type in the collection of the National Museum of Victoria.

Allies: Annectant between *S. nigror* Raym., and *S. relucens* Sm.

The Relucens Complex

Large series of females from all parts of Australia have been investigated in this research, but no male was available, and it is clear that *S. relucens* Sm. constitutes an exceedingly difficult complex for the taxonomist. Perhaps if all the males were known a solution of the problem might be found in the genitalia.

Critical study showed a considerable variation in size, from 5 mm. to 10 mm. in length; typical specimens measure only 7 mm.; females from Cooper's Creek, South Australia, are over 10 mm., and the variation in size is not due to nutritional factors.

The colouring is very similar throughout the large series; the tubercles, scutella and legs being red or ferruginous, and the rest of the insects black. The Cooper's Creek specimens have the scutella suffused with black, and so approach *S. pescotti*, Raym., which has an entirely black scutellum. Most have close appressed metallic ochreous hair, though in certain specimens the hair is silver. Others have the hind margins of the abdominal terga broadly amber, while some are entirely black.

The wasps may be long and exceedingly slender, or they may be short and robust. There are differences in structure; some have the mammiform swelling on the frons, and others lack this character; the prothoracic collar varies from thin to thick; anterior margin of the clypeus may be straight or slightly curvex; the compound eyes may converge strongly, or the margins may be almost parallel.

There are differences in the cruciform structure, and the epinotum, and the neuration of the wings; the recurrents may be far from the intercubiti, or near.

As no better plan for specific separation appears to be available, the author concludes that, until a series of males is available, it is less confusing to refer all these forms to the widely distributed species, *S. relucens*, Sm., with two easily determined new subspecies, *S. relucens ruficornis* and *S. relucens nigricornis*.

Sericophorus relucens Smith. stat. nov.

Cat. Hym. Brit. Mus., IV., p. 357 (N.3), 1856

Female.—Length, 7 mm. approximately. Black, red legs.

Head transverse, closely punctured, clothed with appressed silvery hair; face with a swollen area; frons with a short fine carina; clypeus convex, closely punctured, with three minute nodules; supraclypeal area not defined; vertex with foveae reduced to small purplish marks; compound eyes converging above; genae closely punctured, with much white hair; labrum black; mandibulae dull-amber, black basally and apically; antennae black, claviform, articles not at all "knotted."

Prothoracic collar reddish, with two ivory bands; tubercles reddish; mesothorax black, excessively closely punctured, appressed white hair; scutellum and postscutellum red, closely punctured; metathorax with dorsum of epinotum excavated posteriorly, much white hair laterally; abdominal dorsal segments black, one polished, with scattered fine punctures; others much more closely punctured, hind margins broadly amber, three and four almost banded with white hair; pygidial plate brown, with short thick spines; ventral segments similar. There is no angular tooth laterally on epinotum.

Legs red, coxae and trochanters black, anterior tarsal comb with six strong spines, tarsi suffused with blackish; claws red; hind calcar amber; tegulae reddish; wings hyaline; nervures reddish-brown, first recurrent far distant from the first intercubitus; cells normal for the genus, third intercubitus not contracted at top; pterostigma reddish-brown; hamuli twelve, weak.

Locality: (Topotype) Adelaide, South Australia, leg. N. B. Tindale. Hawkesbury River, New South Wales, leg. A. N. Burns, 31st December, 1930.

Typical specimens in the collection of A. N. Burns, and South Australian Museum, Adelaide.

Allies: (See discussion.) Easily separated from *S. pescotti* Raym., which has a black scutellum, and *S. carinatus* Raym. which has a carina on the clypeus.

Two typical females—topotypes—no lateral tooth on the epinotum; calcar straight. Adelaide, South Australia, February, 1938, leg. Rayment.

One female, almost typical, but darker flagellum. Sandy Creek, South Australia, January, 1940, leg. H. Womersley.

Two females, carded, eyes hardly converging on vertex. McDonald Ranges, Central Australia, September, 1907, leg. "Wallace."

Several large slender females, three nodes on clypeus; the coloured parts ferruginous; posterior margin of tergites light-amber; epinotum minus the lateral angle; recurrents equidistant from the intercubiti, that is, the small triangular second cubital cell receives the second recurrent at about its middle; hind calcar very curved. Darwin, Northern Territory, leg. Gerald F. Hill.

Two females, "taken while catching flies on sheep." Milroy, New South Wales, 20th November, 1913, leg. Cameron.

One typical female, "catching flies on sheep." New South Wales, probably W. W. Froggatt, or Cameron.

One female, with black flagellum. Badja, east of Bredbo, New South Wales, October, 1933, leg. M. E. Fuller.

One female, annectant between *relucens* and *nigricornis*. Marrakai Station, Northern Territory, 28th July, 1929, leg. Messrs. Mackerras and Campbell.

One female, dark anterior legs, scutella very dark-red, and two basal segments of abdomen highly polished; annectant between *relucens* and *ruficornis*. "Taken while capturing flies around cattle." Westmorland Station, North Queensland, 15th May, 1936, leg. "Seamer."

One female, annectant between *relucens* and *ruficornis*. Brock's Creek, Northern Territory, 18th April, 1929, leg. T. G. Campbell.

One female, annectant between *relucens* and *nigricornis*, the hind margins of the terga are quite black. Brisbane, Queensland, 8th January, 1905, leg. Froggatt collection.

One female, typical in all characters except that the hair of the abdomen is entirely white. Wyndham, Western Australia, 3rd December, 1929, leg. T. G. Campbell.

Two females, typical. Thirty-five miles south of Nappamerry, south-west Queensland, 5th November, 1949, leg. E. F. Riek.

One female, typical. Pinjarra, Western Australia, 9th April, 1950, leg. J. A. Mahon.

A typical female, except for pale-amber tegulae, and the recurrents equally distant from the intercubiti. Swan River, Western Australia, leg. S. Clark.

A female, not typical, having black mandibles and tegulae. Bribie Island, Queensland, leg. probably H. Hacker.

One small female, with the light parts ferruginous, with some yellowish-ivory; three teeth on the clypeal margin; broad bands of amber on the abdominal terga; recurrents far distant from the intercubiti; short thick sparce spines on the pygidial plate; epinotum minus the lateral nodes; the six spines of the anterior tarsus much coarser. These forms might be accepted as typical of the species. Bitter Springs, Darwin, Northern Territory, leg. Gerald F. Hill.

The following specimens, in the collection of the Agricultural Department of New South Wales, were studied by the courtesy of the Chief Entomologist, Mr. T. McCarthy:—

One small female, headless, but it appears to be a typical specimen otherwise. Milthorpe, New South Wales, 12th March, 1942, leg. N. S. Lloyd.

One small female, typical in all characters. National Park, New South Wales, 10th December, 1909, T. McCarthy.

One female, typical. Bain?, New South Wales, 5th February, 1931, leg. "W.T.N."

Two females, approaching *nigricornis* by the entirely black antennae. Bathurst, New South Wales, January, 1939, leg. W. C. Lloyd.

Two females, typical, "taken on flowers of *Eucalyptus* sp." Sydney, New South Wales, 26th February, 1902, leg. "W.B.G."

Three females, with bright-red caudal plate, not quite typical. "Taken while catching flies on sheep." Milroy, New South Wales, 20th November, 1913, leg. Cameron.

Two females, typical, Hawkesbury Agricultural College. Richmond, New South Wales, 12th January, 1931, leg. W. Duggan.

One female, typical. Richmond, New South Wales, 2nd December, 1902, leg. W. W. Froggatt.

Two females, annectant between *relucens* and *ruficornis*. Richmond, New South Wales, 2nd December, 1902, leg. W. W. Froggatt.

One large female, approaches *nigricornis*. Chatswood, New South Wales, 2nd November, 1931, leg. Sawkins?

One female, typical. Springwood, New South Wales, 2nd November, 1931, leg. Sawkins?

One female, red parts very bright, caudal plate brown; there are only two cubital cells in the wings; the second intercubitus nervure obsolete. Milroy, New South Wales, 20th November, 1914, leg. Cameron.

A large female, 10 mm. in length, approaching *nigricornis*. Richmond, New South Wales, 2nd December, 1902, leg. W. W. Froggatt.

A typical female. Richmond, New South Wales, 21st January, 1931, leg. J. R. Fisher.

One large female, annectant between *relucens* and *ruficornis*. Cowra, New South Wales, January, 1930, leg. ———.

A female. Wagga, New South Wales, 10th February, 1931, leg. W. Duggan.

Sericophorus relucens nigricornis, subsp. nov.

Female, length, 8–9 mm. in length; abdomen broad, ovate, the red parts often suffused with blackish. Clypeus frequently carinate, anterior margin black, with three small teeth; face with much silvery hair, which sometimes entirely masks the clypeus; antennae black; epinotum with a conspicuous lateral tooth; apical segment somewhat compressed and acute; abdominal terga entirely black, or else showing the merest amber line on the posterior margin; there is a little white hair; apical segment and pygidial plate dark, with short thick dark spines; first recurrent farther distant from the first intercubitus.

A mutation has a peculiar development of the antennal segments (see No. 6, fig 6). The general aspect is blacker, more shining, with less hair.

Locality.—Twenty-five miles east of Durham Downs, South-west Queensland, 11th November, 1949, leg. E. F. Riek.

Cotypes in the collection of the Entomological Division, C.S.I.R.O., Canberra, A.C.T.

One female, near *nigricornis*, but has clypeus nude. Lake Meran, Victoria, 15th December, 1946, leg. R. Trebilcock.

One female annectant between *relucens* and *nigricornis*. Victoria Valley, Victoria, 26th February, 1949, leg. Bruce Given.

Three females, with lateral tooth of the epinotum very large; annectant between *relucens* and *nigricornis*. Kerang, Victoria, 21st December, 1916, leg. R. Trebilcock.

One female, annectant between *relucens* and *nigricornis*. Hawkesbury River, New South Wales, 31st December, 1930, leg. A. N. Burns.

One female, annectant between *relucens* and *nigricornis*. Westwood, Central Queensland, 28th November, 1923, leg. A. N. Burns.

A series of 22 large females, collected over several years. Brisbane, Queensland, 1912–15–16–22, leg. H. Hacker.

Several females. Darwin, Northern Territory, leg. W. K. Hunt.

One female, annectant between *relucens* and *nigricornis*. Richmond, New South Wales, 2nd December, 1902, leg. W. W. Froggatt.

One female, very slender abdomen, annectant between *relucens* and *nigricornis*. Hay, New South Wales, 13th January, 1916, leg. W. W. Froggatt.

Twenty-three females (taken from blowfly trap). Black Mountain, Canberra, A.C.T., 2nd February, 1931, leg. I. J. Mackerras.

One female, Badja, east of Bredbo, New South Wales, October, 1933.

Three females, not typical, and remarkable for having the dorsum surrounded by a pitted sulcus. Thirty-three miles west of Kihee, South-west Queensland, 12th October, 1949, leg. E. F. Riek.

One female. Yanko, South-west Queensland, 8th November, 1919, leg. E. F. Riek.

One female, dorsum defined by a pitted sulcus; these appear to be related to the Kihee specimens, and perhaps should be separated as a subspecies. Forty miles west of Bourke, New South Wales, 28th October, 1949, leg. E. F. Riek.

Two females, Twenty miles south of Milparinka, New South Wales.

Two large females, annectant between *relucens* and *nigricornis*. Thirty-five miles south of Nappamerry, South-west Queensland, 5th November, 1949, leg. E. F. Riek.

Large robust female; epinotum lacks the lateral angular tooth; apical margin of segments of abdomen red; mandibles and antennae black; three nodules on clypeal margin, annectant between *relucens and nigricornis*. Kuranda, North Queensland, leg. P. Dodd.

Small robust female, legs almost black, annectant between *relucens* and *nigricornis*. Kerang, Victoria, 17th January, 1947, leg. R. Trebilcock. Kerang, Victoria, 11th December, 1946, leg. R. Trebilcock.

Numbered specimens are in the collection of the Western Australian Museum; the dates are not indicated on the labels.—

One large typical female. Tunney, Western Australia, No. 33–362, leg. A. M. Douglas.

Two large females. Wickepin, Western Australia, No. 33 206 and No. 33 205, leg. A. M. Douglas.

One large female. Subiaco, Western Australia, March, 1913, No. 6969, leg. A. M. Douglas.

Sericophorus relucens ruficornis sub-sp. nov.

These females are longer, 10 mm. in length, and very slender when compared with *nigricornis;* the reddish colour tends to become ferruginous. Clypeal region nude, with three small nodular teeth on the anterior margin, which is somewhat reddish; the clypeus is never carinate; in typical specimens the scape as well as the flagellum is ferruginous; scutellum, post-scutellum, tubercles, tegulae, and legs all ferruginous-red; a small tooth laterally on the epinotum; pygidial plate redder, with longer, paler, finer spines; the posterior margins of the terga broadly ferruginous; and there is much ochreous and golden hair; nervures of wings pale-amber, recurrent nervures equally distant, and far from the intercubiti. Seven spines on the anterior tarsal comb.

Locality:—Type specimen, Tennants Creek, Central Australia, leg. J. F. Field. Darwin, Northern Territory, leg. W. K. Hunt.

Type in the collection of the South Australian Museum.

Two females, typical except for the dark scape. The Springs, Westmoreland Station, North Queensland, 30th September, 1930, leg. T. G. Campbell.

One female, not quite typical, annectant between *relucens* and *ruficornis*. Cunnamulla, Queensland, October, 1941, leg. A. J. Turner.

Two females, not quite typical, having a darker scape. Bribie Island, Queensland, November, 1918, leg. H. Hacker.

Several typical females. Cooper's Creek, Central Australia, leg. J. G. Reuther.

Small slender female, apical segments of abdomen very red, antennae ferruginous. Lake Neran, Victoria, 1st February, 1947, leg. R. Trebilcock.

Several females, long and slender, with three large clypeal teeth, apical segments of abdomen very red, excessively hairy, incisure of epinotum very different. Queensland, 20th August, 1899, leg. Dr. Symons.

A small slender female, teeth large, red nearer ferruginous. Queensland, August, 1889, Dr. Symons per Dr. Stirling.

A slender female, very hairy, three small clypeal teeth, reddish parts light-ferruginous, terga broadly amber, epinotum different, annectant between *relucens* and *ruficornis*. Owieaniana, South Australia, leg. Messrs. Hale and Tindale.

A robust female, light parts all light—ferruginous. Sandy Creek, South Australia, January, 1940, leg. H. Womersley.

A similar female, with the apical half of the abdominal terga amber. Allendale, South Australia, collector unknown.

One female, annectant between *relucens* and *ruficornis*. Lake Meran, Victoria, 1st February, 1947, leg. R. Trebilcock.

One female, annectant between *relucens* and *ruficornis*. Brisbane, Queensland, 12th February, 1912, leg. H. Hacker.

Two females, annectant between *relucens* and *ruficornis*. Forest River, North-west Australia, leg. W. Crawshaw.

Three females, with large lateral tooth on metathorax, annectant between *relucens* and *ruficornis*. Thangoo, south of Broome, Western Australia, leg. I. M. Makerras, 4th September, 1934.

One female, annectant between *relucens* and *ruficornis*. The Springs, Westmoreland Station, North Queensland, 30th September, 1930, leg. T. G. Campbell.

One female, annectant between *relucens* and *nigricornis*. Bathurst, New South Wales, 3rd February, 1931, leg. E. G. Hall.

One female, not typical by the broadly rufous posterior margins of abdominal terga. A very old specimen in confusing condition. Roseville, New South Wales, 28th October, 1931, leg. ———.

Numbered specimens are in the collection of the Western Australian Museum; dates are not indicated on the labels.—

One small female, annectant between *S. relucens* and *ruficornis*. Narrogin, Western Australia, No. 37–3942, leg. A. M. Douglas.

One small female, annectant between *S. relucens* and *ruficornis*. Wickepin, Western Australia, No. 33–203, leg. A. M. Douglas.

One small female, annectant between *S. relucens* and *ruficornis*. Wandagee, Western Australia, No. 37–2338, leg. A. M. Douglas.

One small female annectant between *S. relucens* and *ruficornis*. South Perth, Western Australia, January, 1916, leg. A. M. Douglas.

Two females annectant between *S. relucens* and *ruficornis*. Salmon Gums? Western Australia, Nos. 41–55 and 40–313, leg. A. M. Douglas.

Sericophorus rufobasalis, sp. nov.

Type, male.—Length 6 mm. approximately. Black, red legs.

Head transverse, densely covered with appressed silvery hair; face finely rugoso-punctate; frons with a low mammiform swelling; clypeus closely punctured, with the clypeal angle inconspicuous, and not produced to a tooth; supraclypeal area not defined; vertex with the eyes converging slightly, compound eyes large; genae practically the same as the rest of the head; labrum small, black; mandibulae amber, with dark tips; antennae short, submoniliform, black beneath, amber above, segments wider than long.

Prothorax black, suffused with reddish, but has a yellowish line; tubercles ferruginous; mesothorax excessively closely punctured; scutellum and postscutellum red, punctures larger on the former; metathorax with the stem of the cruciform incisure widest, much white hair, a large lateral tooth; abdominal dorsal segment one red, polished (some specimens have a median black patch), other segments black, margins broadly amber, much appressed white hair, finely and closely punctured, pygidial plate with long pallid spines; ventral segments polished.

Legs ferruginous-red; tarsi red, anterior tarsal comb with six fine amber spines; pulvillus not excessively developed; claws red; hind calcar pale-amber; tegulae amber; wings brownish; recurrent nervures equally distant from the intercubiti, basal straight; second cubital cell triangular; pterostigma brown, darker margin; hamuli about thirteen.

Allies: Probably derived from *S. relucens* Sm., but easily separated by its small size and red basal segment; the absence of clypeal teeth is a sex character.

Type in the collection of the Queensland Museum.

Cotypes in the collection Entomological Division, C.S.I.R.O., Canberra, A.C.T.

Locality.—Brisbane, Queensland, October, 1915–16, leg. H. Hacker.

Typical male. Females with red maculae on base of abdomen may be the other sex. Cairns, Queensland, leg. A. M. Lea.

Seven typical males with basal segment very red. Bourke, New South Wales, 27th October, 1949, leg. E. F. Riek.

One male, typical in all characters. Twenty-five miles east of Tibooburra, New South Wales, 1st November, 1949, leg. E. F. Riek.

One male, typical in all characters. Brisbane, Queensland, 8th January, 1935, leg. probably H. Hacker.

One male, typical in all characters. Badja, east of Bredbo, New South Wales, October, 1933, leg. M. E. Fuller.

A series of ten males, topotypes. Brisbane, Queensland, 26th October, 1910, leg. H. Hacker.

The following specimens are in the collection of the Agricultural Department of New South Wales:—

One male, 8 mm. in length, larger than the type, has the angle of the clypeus developed to a definite black tooth. The red portions are entirely ferruginous, even the basal segment of the abdomen. Mittagong, New South Wales, 10th January, 1902, leg. W. W. Froggatt.

One female, larger than the type, with the red of the basal tergum reduced to two large lateral maculae. This form has been received from several other localities, and should perhaps be separated, but until the male is known it is referred to *rufobasalis*. Richmond, New South Wales, 2nd December, 1902, leg. W. W. Froggatt.

Sericophorus rufipes, sp. nov.

Type, female.—Length, 11 mm. approximately. Bluish-green, red legs.

Head dull-green, sericeous; face with the merest median rise; frons very smooth, with minute pilferous punctures; clypeus dark-green, dull, with much long white hair, and two large clypeal black teeth, many large coarse punctures; supraclypeal area not defined; vertex with a few white hairs; compound eyes converging a trifle above; genae with rather long white hair; labrum red; mandibulae ferruginous; antennae with suffused scapes and pedicel, flagellum clear-ferruginous.

Prothoracic collar not so appressed as in other species; tubercles blacker, with a fringe of white hair; mesothorax dull bluish-green, sericeous, scattered piliferous punctures; the black hair has white tips, anteriorly there are four sutures, two short and two long; scutellum green, conspicuously tuberculate, shining; postscutellum duller, with closer punctures; metathorax brighter, with considerable white hair, dorsum almost tessellate, closely punctured, numerous fine transverse striae below the dorsum; abdominal dorsal segments bluer, dull, closely and finely punctured, white hair almost in bands laterally, pygidial plate brown, with short coarse spines; ventral segments polished, with prismatic blue and green tints.

Legs ferruginous, coxae, trochanters, and femora basally bluish; tarsi ferruginous; claws ferruginous, pulvillus pale (black in most species); hind calcar reddish; tegulae brown; wings yellowish-hyaline; nervures ferruginous, recurrents far distant from the intecubiti; second cubital cell triangular, third cubital not contracted at top; pterostigma ferruginous; hamuli thirteen.

Locality.—Tasmania, "No. 2657, Lefroy."

Type in the collection of the South Australian Museum.

Allies: S. *sydneyi* Raym., which is smaller and bluer, with ferruginous tibiae, but the two insects are very close. *Sydneyi* has very dark neuration on the wings. The new species is easily known by its dull colour, white hair, and ferruginous neuration.

Maxwell Lefroy, the English entomologist, visited Tasmania, but the author is unable to discover whether or not he collected this insect.

Sericophorus rufotibialis, sp. nov.

Type, male.—Length, 8 mm. approximately. Dull-blue, red tibiae.

Head transverse, dull-sericeous; face with much white hair below, but less black hair above; frons hardly swollen; clypeus blackish, closely punctured, without teeth, not even the anterior angle developed; supraclypeal area not defined; vertex finely developed, with black hair; compound eyes converging a little above; genae microscopically tessellate, with white hair; labrum black; mandbulae reddish, darker on margin and apically; antennae short, black, thick, clavate.

Prothoracic collar not so appressed as in other species, a line of white hair; tubercles black, with a fringe of white hair; mesothorax dull, microscopically tessellate, numerous shallow piliferous punctures, a few black hairs; scutellum of similar sculpture, but darker, shining, and tuberculate; postscutellum blacker, shining, punctures more distinct; metathorax with dorsum defined by a fine ruga enclosing a rugoso-punctate reticulated area, seven or so coarse transverse rugae laterally; abdominal dorsal segments sericeous, with close piliferous puncturing and black and white hair; broad pygidial plate with short thick spines; ventral segments more polished.

Legs blue, except the red tibiae; tarsi all dark, except the red fifth, anterior comb of six red spines; claws red; hind calcar red; tegulae dull-piceous; wings subhyaline; nervures brown, recurrents equally distant from the intercubiti; cells normal for the genus; pterostigma blackish-brown; hamuli twelve.

Locality.—Blundells, 20 miles west of Canberra, A.C.T., 29th December, 1949, leg. E. F. Riek.

Type in the collection of the Entomological Division, C.S.I.R.O.

Allies: *S. chalybaeus* Sm., but easily separated by the absence of clypeal teeth, black flagellum and dark legs.

Sericophorus rugosus, sp. nov.

Type, female.—Length, 8 mm. approximately. Blue and green.

Head greener than thorax, with smooth microscopic tessellation; face with white hair on anterior portion; frons with a low mammiform swelling; clypeus black, two large nodes, outer one largest, angle almost developed to a node; supraclypeal area not defined, with closer punctures; vertex nude; compound eyes converging slightly above; genae with fine piliferous punctures and white hair; labrum brownish-red; mandibulae reddish, with much white hair basally; antennae missing from specimen.

Prothorax greenish, with some white hair; tubercles bluish; mesothorax sericeus, but smooth, bright, with inconspicuous piliferous punctures, and white hair near the scutellar suture; scutellum brighter, smooth, with a few punctures; postscutellum with close punctures; metathorax greener, with numerous rugae that is difficult to describe (see No. 11 in pl 5); pygidium hidden under a smooth black mass, but it has long coarse spines; abdominal dorsal segments greenish-blue, shining, with minute piliferous punctures, and a dusting of fine white hair; ventral segments more shining.

Legs bluish, but tibiae suffused with dark-reddish; tarsi red, suffused with reddish-brown; anterior comb with four long coarse spines; claws red; hind calcar dark-brown; tegulae dull-piceous, bluish basally; wings hyaline; nervures pale-sepia, the recurrents equally distant from the intercubiti; third cubital cell much contracted at top; pterostigma amber, with brown margin; hamuli eleven.

Locality.—Brisbane, Queensland, 10th October, 1916, leg. H. Hacker.

Type in the collection of the Queensland Museum.

Allies: *S. claviger* Kohl., which is smaller, with one tooth on the clypeus; *S. patongensis* by the rugose metathorax; legs of *S. claviger* much redder; *S. metallescens* is allied.

Sericophorus spryi, sp. nov.

Type, male.—Length, 9 mm. approximately. Blue, black head, red legs.

Head transverse, shining, closely punctured; face with a median tubercle; frons closely punctate, with scattered white hair; clypeus shining, closely punctate, anterior margin with one tooth; supraclypeal area produced to a large node; vertex compressed, with much black hair; compound eyes reniform; genae finely punctate, with a basal nodule, a few white hairs; labrum reddish; mandibulae ferruginous, blackish apically, typical of the genus; ferruginous antennae, scapes pedicel and apical segment black.

Prothoracic collar blackish-blue, pressed back flat against the scutum; a line of white hair, finely tessellate; tubercles blue, a fringe of white hair; mesothorax blue dull-sericeous, large punctures not contiguous, a few erect

black hairs; scutellum more shining, with a tubercle; postscutellum closely and finely punctate; metathorax blue, the cruciform constructure imposed on a fine oblique rugoso-punctate sculpture, the extreme lateral margins of which are deeply pitted; abdominal dorsal segments blue, shining, with a microscopic lineation, and close fine punctures, pygidial plate dark-brown; ventral segments more shining.

Legs ferruginous, coxae, trochanters and femora basally bluish; tarsi ferruginous, four basal segments darker; claws red, pulvillus black; hind calcariae red, one twice the length of the other; tegulae bright, piceous; wings hyaline; nervures amber, the recurrents about equally distant from the intercubiti, equallying the length of the apex of the second cubital cell; pterostigma large, palest-amber, margined with brown; hamuli eleven. (One specimen lacks the second intercubitus nervure, having only two cubital cells. See No. 2, text fig. 2.)

Locality.—Chelsea, Victoria, leg. late Frank Spry. Cavendish, Victoria, 8th January, 1948, leg. "B.G.?"

Type in the collection of the National Museum of Victoria.

Cotype in the collection of the author.

Allies: The abdomen is almost cordate. It is close to *S. claviger* and *S. violaceus* Raym., which is much larger, with two clypeal teeth.

Sericophorus subviridis sp. nov.

Type, female.—Length, 9.5 mm. approximately. Metallic-greenish, red legs.

Head transverse, dull-sericeous; face with scattered white hair, and a longitudinal carina produced to a median tubercle, and reaching the median ocellus; clypeus convex, with reddish patches, closely punctured, anterior margin with three low mammiform teeth, the two outer ones longest; vertex very short, a few white hairs; foveae reduced to obscure darker marks; compound eyes reniform; genae finely punctured, a few white hairs; labrum reddish; mandibulae entirely amber; antennae entirely bright-ferruginous.

Prothorax with a few white hairs; tubercles green; mesothorax sericeous, dull-green, inconspicuous piliferous punctures; scutellum shining black, scattered punctures, a large tubercle; postscutellum shining, hardly punctured; metathorax shining, bluer, with numerous transverse fine carinae below and laterad of the cruciform structure; abdominal dorsal segments somewhat slender, greener, a sprinkling of appressed white hair, basal produced into a median tubercle, pygidial plate dark brown, with a few short peg-like spines basally; ventral segments green, shining.

Legs entirely bright clear-ferruginous, only the coxae blue; tarsi ferruginous, seven long spines on anterior basitarsal comb; claws dark-red, pulvillus black; hind calcar bright-red; tegulae piceous; wings hyaline; nervures blackish-brown, first recurrent falls far distant from the first intercubitus; cells normal; pterostigma blackish.

Locality.—Victoria Valley, Victoria, 26th February, 1949, leg. "B.G.?"

Type in the collection of A. N. Burns.

Allies: Clearly close to *S. victoriensis*, which has two clypeal teeth, short spines on the pygidial plate, and light-ferruginous legs. Easily separated by the all white hair.

Sericophorus sydneyi, sp. nov.

Type, female.—Length, 9.5 mm. approximately. Greenish-blue, red legs.

Head dull-sericeous, inconspicuous piliferous punctures; face has considerable appressed white hair; frons divided by a fine black line, and a microscopic tubercle; green clypeus has three teeth on anterior margin; the third smallest; supraclypeal area not defined; vertex with considerable white hair; compound eyes reniform; genae with considerable white hair; labrum reddish; mandibulae amber, dark-red apically; antennae ferruginous, the scapes faintly suffused.

Prothorax has considerable white hair; tubercles bluish, with white fringe; mesothorax dull, bluer, with piliferous punctures, and some black hair; scutellum similar, but developed to a large compressed tubercle; postscutellum with closer punctation; metathorax with numerous fine transverse carinae that persist across the whole declivity of the epinotum; the dorsum shining green, with numerous punctures; the hair is all white except on the scutum; abdominal dorsal segments bluer, dull-sericeous with considerable white hair laterally, basal with a tubercle, black pygidial plate with very fine spines; ventral segments almost polished.

Legs ferruginous, only the coxae and trochanters green; tarsi and claws red; hind calcar ferruginous; tegulae dull-piceous, closely punctate; wings hyaline; nervures blackish, first recurrent far distant from the first intercubitus, third cubital cell hardly contracted at top; pterostigma brown, margined with black; hamuli thirteen.

Locality.—Bolgart, Western Australia, 16th April, 1950, leg. Rica Erickson.

Type in the collection of the National Museum of Victoria.

Allies: Plainly close to *S. chalybaeus* Sm., which has dark femora scapes and pedicel, and is larger, but the structure of the epinotum is very different, the species is dedicated to Sydney Erickson in appreciation of his assistance in collecting.

Sericophorus tallongensis, sp. nov.

Type, male.—Length, 8 mm. approximately. Metallic-green, black head.

Head black, transverse, close punctation of medium size; face with white hair on lower part, black hair on upper half; frons with a large swelling, and a small depression; clypeus with close punctures, larger on anterior half, with one tooth (as in *claviger*); supraclypeal area rising to a short carina; vertex rather finely produced; compound eyes reniform, anterior margins parallel; genae sericeus, piliferous punctures, white hair; labrum blackish; mandibulae black, obscure reddish tints; antennae black above, ferruginous beneath, the segments produced to a node, the apical one of a peculiar form.

Prothorax closely appressed to mesothorax; tubercles black, white hair; mesothorax sericeus-green, many punctures of medium size, erect black hair; scutellum similar, but tuberculate, shining, with larger punctures; postscutellum with closer smaller punctures; metathorax shining, finely rugoso-punctate, stem of cruciform incisure with sides parallel; four or so short rugae laterally, some black and white hair; abdominal dorsal segments sericeus-green, smoother than mesothorax, finer punctures, a few pale hairs, pygidial plate reddish, with fine spines; ventral segments similar.

Legs bluish, base of femora and all of tibiae dark-red; tarsi dull-reddish, suffused with brown; claws amber; hind calcar blackish; tegulae amber, black basally; wings hyaline; nervures sepia, normal for the genus, first recurrent farthest from first intercubitus; cells; third cubital much contracted at top; pterostigma sepia, darker margin; hamuli eleven.

Locality.—Tallong (altitude 2,000 feet), New South Wales, December, 1950, leg. Norman W. Rodd.

Type in the collection of the National Museum of Victoria.

Allies: *S. viridis* by the black head; *S. claviger* by the clypeal tooth, but *claviger* is very much smaller.

Taken with other males, which were diving down into the shafts.

Sericophorus teliferopodus, sp. nov.

Type, female.—Length 12 mm. approximately. Metallic bluish-green, red legs.

Head sculptured and coloured as in the male; face with white hair; clypeus with white hair more dense, and a red triangle, otherwise similar to male, anterior margin with three nodes laterally; supraclypeal area not defined; vertex with black hair, sharply developed; compound eyes with anterior margins parallel; genae inconspicuous, no malar area in either sex; labrum oval, reddish; mandibulae amber, darker apically; scapes short, blackish, flagellum reddish-ferruginous, with apical segments wider than long in both sexes.

Prothorax with white hair laterally; tubercles blackish; pleura blue, shining, a delicate tessellation; mesothorax with a sericeus sculpture; scutellum with a low median elevation and black hair, many punctures; postscutellum shining, with black hair; metathorax bluish, with a cruiciform incisure as in the male; abdominal segments prismatic greenish-blue, closely punctured, shaped like a peg-top, that is, the second visible tergum is widest; apical segments and pygidial plate red, hind margins aeneas, a few white hairs laterally; ventral segments greenish, more highly polished; gradulus of sternum inconspicuous.

Legs bright-red, coxae, trochanters, and femora basally greenish-black; tibiae conspicuously spinose on outer surface; tarsi red, spinose, the fifth expanded; pulvillus excessively large, black, and formed like a complex web which, when open, resembles a large "paw"; claws small, reddish; hind calcariae red, finely serrated, one much longer than the other; tegulae piceous; wings entirely hyaline, with microscopic black hairs; nervures brown, first recurrent entering first cubital cell at about its apical fourth; second cubital cell small, greatly contracted at apex, receiving second recurrent at its apical fourth; pterostigma long, pale-amber, with darker magin; hamuli ten. The red pygidial plate of the abdomen with coarse amber spines.

Abdomen smaller than the strong thorax, and terga 3–4–5 (visible) have much appressed golden hair; several specimens have a brassy shade, with lilac reflections.

The Sandringham females are larger and more robust than one taken at Warburton, Victoria, leg. Chas. Oke.

Allotype, male.—Length, 7 mm. approximately. Metallic bluish-green.

Head transverse, blackish-green, with many punctures and a fine tessellate sculpture; face excavated around bases of scapes, some white hair laterally at base; frons with a large smooth tubercle and a median sulcus as in the female; clypeus black, shining, convex, closely punctured, anterior angle with a lateral nodule; supraalypeal area not defined, but rising to a median carina; vertex with black hair; compound eyes with anterior margins parallel; genae with fine punctures, a delicate sculpture, and a few white hairs; labrum a small oval; mandibulae dull-ferruginous; antennae with short black scapes, flagellum dull-ferruginous beneath, apical segment modified.

Prothorax lighter-green; tubercles blackish, with a fringe of white hair; mesothorax greener, a well-marked tessellate sculpture and many punctures giving a morocco-leather aspect; scutellum sub-tuberculate, a few black hairs, shining and blacker; postscutellum shining, with black hair; metathorax greenish-blue, shining, a wide sulcus formed like the letter "T", the groove divided by a number of transverse rugae; abdominal dorsal segments prismatic greenish-blue, apical segments red; the abdomen is of a peg-top form, with a red pygidial plate; ventral segments as in the female.

Legs red, slender, tibiae, armed with spiculae, darker parts as in female; tarsi amber, fifth large, with a conspicuous black pulvillus; claws small, as in female; hind calcariae red, one larger than the other; tegulae piceous; wings entirely hyaline; nervures as in female with the basal short, straight, and meeting nervulus; radial cell pointed on the costa; pterostigma long, pale, with a darker margin; hamuli ten.

Type locality, Sandringham, Victoria, 12th January, 1950, leg. Rayment. Cheltenham, Victoria, leg. F. E. Wilson.

Type, allotype, and cotype in the collection of the National Museum of Victoria.

It is not very close to *S. chalybaeus,* Sm., but nearer to *S. rufipes,* sp. nov.

Sericophorus teliferopodus okiellus, sub-sp. nov.

A female, slightly smaller than the species, but a trifle larger than the smaller form (see Table of Development). The insect is bluer, with much less hair, and lacks the coppery tints on the abdomen.

The two nodular teeth of the clypeus are minute (the angle is developed to a low nodule in the species); scapes clear ferruginous; the tubercle of the frons is highest on the black mark (it is highest below the mark in the species.

The scutellar tubercle is black and more prominent; dorsum of the epinotum has oblique rugoso-punctate sculpture laterad of the cruciform incisure, the stem of which is without transverse rugae (dorsum distinctly punctured and without rugae in the species); the large carinae below are irregular; pygidial plate truncate at extreme tip (rounded in the species), and the apical half has no spines.

Abdomen short and ovate, and almost nude; the femora with more red; nervures blacker, the second recurrent very close to the second intercubitus.

Locality: Melton, Victoria, 27th December, 1947, A. N. Burns.

Allies: Easily separated from *S. viridis* Sauss., which has a black head, by the ferruginous scapes.

The species is dedicated to Chas. G. Oke in appreciation of his assistance.

Sericophorus victoriensis, sp. nov.

Type, female.—Length, 10 mm. approximately. Dark greenish-blue, ferruginous legs.

Head dull-sorveous, with a sprinkling of white hair; frons with a short carina; clypeus blue, prominent, laterally with two teeth, outer one larger than the other; supraclypeal area not defined; vertex with a few black and white hairs; compound eyes reniform; genae with a few white hairs; labrum black; mandibulae amber basally, dark red apically; antennae entirely ferruginous, with a black dot apically.

Prothoracic collar not so closely appressed; tubercles bluish, with a fringe of white hair; mesothorax dull sericeus, as in *chalybaeus*, but pilose punctation not so close; scutellum with a conspicuous black ridge-like tubercle; postscutellum rougher; metathorax with many fine transverse carinae below the cruciform structure; abdominal dorsal segments greener, and more shining than those of *chalybaeus*, second morphological with a median tubercle as in *teliferopodus*, pygidial plate with short pegs basally; ventral segments more shining, simple.

Legs clear-ferruginous, only coxae and trochanters blackish; tarsi ferruginous; claws red; hind calcariae red, one much larger than the other; tegulae dull, piceous; wings faintly fulinginous; nervures brownish, recurrents about same distance from intercubiti; cells; third cubital hardly contracted at top; pterostigma brown; hamuli thirteen, strong.

Locality.—Portland, Victoria, February, 1913, leg. J. E. Dixon.

Type in the collection of the National Museum of Victoria.

Allies: *S. subviridis*, Raym., which has a bronze-green abdomen, and three teeth of red clypeus more widely spaced, and pygidial plate entirely covered with long coarse spines.

Sericophorus violaceus, sp. nov.

Type, female.—Length, 10 mm. approximately. Shining violet, with pale-ferruginous legs.

Head transverse, practically black in colour; face with rather long white hair; frons with a median elevation, and many punctures; clypeus prominent, the ferruginous colour reaching the base of the compound eyes, anterior margin with two small contiguous mammiform tubercles; vertex with white hair; compound eyes reniform; genae with white hair; labrum, mandibulae and antennae clear light-ferruginous, apical segment of flagellum black.

Prothorax blue, appressed, a few white hairs; tubercles black, with a fringe of ochreous hair; mesothorax with the sericeous lustre of the genus, but more shining than *chalybaeus*, a few black hairs, and numerous large punctures; scutellum almost black, subtuberculate, many large punctures; postscutellum bluer, with a closer punctation; metathorax with six short carinae below the cruciform structure, black hair laterally; abdominal dorsal segments shining, closely punctured, apical segments red, pygidial plate with stout spines of medium length; ventral segments similar, but more shining.

Legs clear pale-ferruginous, only the coxae blue; tarsi pale-ferruginous; claws ferruginous, pulvillus large and black; hind calcar ferruginous; tegulae amber; wings faintly amber; nervures golden-brown; cells typical of the genus; pterostigma amber, margined with brown; hamuli thirteen.

Allotype, male.—Length, 6.5 mm. approximately. Coloured like the female, but much smaller, and clypeus blue-black.

Head almost black; face with an obscure greenish lustre; frons with a small carina ending in a minute basin; clypeus blacker, closely punctured, with one small nodule on anterior margin; supraclypeal area not defined; vertex with a few black hairs; compound eyes reniform; genae with white hair; labrum amber; mandibulae amber, darker basally and apically; antennae clear-ferruginous, apical segment modified, black.

Prothorax excessively reduced; tubercles blackish; mesothorax, scutellum and postscutellum as in female; metathorax with only four lateral carinae, but polished; abdominal dorsal segments very lustrous, and rich-coloured violet; apical segments clear pale-ferruginous; ventral segments more polished.

Legs clear, ferruginous as in female; tarsi, claws and hind calcar all ferruginous; tegulae brownish-amber; wings hyaline; nervures with outer recurrent and intercubitus weakened; the first recurrent falls far short of the first intercubitus; appendiculate cell weak in female; obsolete in male; hamuli eleven, weakly developed.

Locality.—Torrens Gorge, South Australia, January, 1940, leg. J. Womersley.

Type and allotype in the collection of the Adelaide Museum.

Allies: *S. chalybaeus* Sm., which is quite dull, with white hair on the metathorax. *S. violaceus* is the brightest and most beautiful species in the genus.

There is little doubt that this association of the sexes is correct.

Sericophorus viridis (Saussure).

Mem. Soc. Physique et Hist. Nat. Geneve, XIV., pt. 1, p. 25, 1855

(Since the original description is not available in Australia, the author gives the following translation from the French. The words in brackets are his.)

Female.—Length, nearly 10 mm.; of the wings 5.5 mm.

Head shining, blackish, and clothed with a rather long silky down (or pile) after the style of part of the posterior; mandibulae and palpi reddish; clypeus reddish; except the anterior margin, which is blackish, and terminated on each side by a small tooth directed down. Antennae of a ferruginous-orange; thorax very finely punctured; mesothorax bearing upon its anterior part two small furrows. Scutellum a little raised on middle. The furrow (cruciform structure) of the metathorax, coarsely punctured on the back, is continued so that it encloses the hind margin of the postscutellum. Plate at the back of the post-scutellum (epinotum) transversely striate. Thorax of a metallic bluish-green, garnished (or clothed) with a downy pile of black hair; abdomen of a metallic green, bluer at the base, and passing (shading) to copper-colour towards the end; segments third and fourth of a coppery-green; the fifth brown, and the sixth red; the ventral surface black. All the abdomen covered with a ferruginous silky pile, the hair a little golden. Claws reddish; pulvilli (pelottes—a pad) and tarsi, coxae, trochanters, and base of femora blackish. Wings transparent, a trifle smoky; nervures brownish, pterostigma (écailles—a scale) brownish; second cubital cell triangular, the radial margin not so.

From New Holland.

The following additional characters will assist the student to separate this species. The lower part of the face has considerable appressed silvery hair, and actually there are two large teeth on the anterior margin of the clypeus, the outer one being quite long; the scutellum is green, with only the tubercle blackish; postscutellum greener, with scattered punctures, the lateral carinae of the epinotum are few, but coarse and conspicuous; pygidial plate is red, with close-set long spines; seven long evenly spaced strong spines on the anterior tarsal comb; pterostigma amber, with a darker margin.

New locality.—Mt. Victoria, New South Wales, 5th January, 1931, leg. A. N. Burns.

These females differ from the type by the ferruginous coxae and trochanters, and some have a black spot on the apical segment of the flagellum.

Allies: Close to *S. teliferopodus*, which has three clypeal teeth, and lacks the coppery hair of the abdomen. The type is probably a male.

Sericophorus viridis roddi, subsp. nov.

A series of females from the South Coast of New South Wales are slightly smaller, with the clypeus more or less suffused with bluish laterally, and there are three nodular teeth on the anterior margin; antennae with the apical segment largely black. Pygidial plate darker.

The legs are of a darker red, the coxae, trochanters and base of femora dark, and there are seven long strong spines on the anterior tarsal comb. The abdomen shows lilac tints in certain lights.

The first recurrent is far distant from the intercubitus.

The spines of the pygidial plate are fewer, shorter and coarser, than in the species, and the scultpure of the dorsum is coarser, and there are fewer, but coarser transverse striae below.

These females will probably be raised to full specific rank when more is known about them.

Locality.—Fraser Park, New South Wales, 27th December, 1947, leg, Norman W. Rodd.

Paratypes in the collections of Rodd and Rayment.

One female, with yellowish wings, and the incision on the inner margin of the spoonlike mandibles subobsolete. Spines on pygidium short and stout. First recurrent farther from the first intercubitus nervure; may have to be separated when the male is known. Id. by Froggatt as *S. viridis.* Shoalhaven, New South Wales, 1895, leg. probably W. W. Froggatt.

A Derivative Genus

A group of black wasps differ from *Sericophorus* by the absence of the cruciform incisure on the dorsum of the epinotum. These distinctive species are easily separated, and the author proposes a new genus, *Anacrucis,* to include them.

The incisure is probably a development of the pitted sutures of the thorax, for similar short transverse rugae are present in the scutellar sutures of the *S. relucens* complex. (Fig. 10, pl. 5.) The fine longitudinal line on the dorsum of *Anacrucis* is undoubtedly a vestigial remnant of the structure.

Hymenopterists have shown in *Colletes* and *Halictus,* APOIDEA, that rugose sculpture is more primitive than smooth integument, and on the phylology, *Anacrucis* could be derived from *Sericophorus.*

Morphologists will agree that it is easier to lose a character than to acquire a new one, and in *Sericophorus rugosus* and *S. metallescens,* the incisure is definitely weakened. (Figs. 7 and 11, pl. 5.) The absence of the character could be explained by a genetical defect, loss of the genes responsible for the structure.

Anacrúcis, genus nov.

(*An*—not, and *crucis*—a cross)

Sericophorine wasps of medium size, with large heads, and short submoniliform antennae; mandibles spoon-like, the incision of the inner margin adapted to the clypeal teeth or nodules as in *Sericophorus.* The mouth-parts

could not be removed for comparative studies. Labrum larger; facial foveae clearly defined as depressed areas; frons with a mammiform swelling. Females may have only one clypeal tooth.

The prothoracic collar is not so appressed, and is thickened laterally; the scutal and parapsidal furrows of the mesothorax inconspicuous; propodium large, smooth, without coarse rugae, the cruciform incisure obsolete.

The general aspect of the abdomen is brighter, and the terga smoother, but the pygidial plate is coarely spined. The legs are strong, but the spiculae of all are very much weaker; the fifth tarsus and pulvillus smaller; anterior tarsal comb strongly spinose; posterior calcariae much shorter.

The wings are dark, and the basal nervure somewhat arched; the second recurrent nervure far distant from the second intercubitus; third cubital cell narrower; hamuli more numerous.

Males not known.

Type locality.—Frankston, Victoria, probably collected by the late F. Spry.

Anacrucis laevigata gen. et sp. nov.

Genotype, female.—Length, 11 mm. approximately. Black, red legs.

Head transverse, covered with appressed golden hair; frons with the mammiform swelling divided by the frontal line so that it becomes bituberculate; clypeus sericeus, closely punctured, with three subequal teeth on anterior margin, inner one longest; supraclypeal area not defined, but " face " excavated anteriorly; vertex with ocelli on prominences in a triangle; compound eyes converge only slightly above; genae sericeus, with appressed white hair; labrum more convex, dark-red; mandibulae more spoon-like, dull ferruginous, otherwise like *Sericophorus;* antennae with short black scapes, flagellum black above, ferruginous beneath, submoniliform.

Prothorax not so appressed as in *Sericophorus,* with white hair; tubercles black, with a fringe of white hair; mesothorax dull-sericeous, closely punctured, practically nude; scutellum and postscutellum similar; metathorax with dorsum almost polished, a fine longitudinal line, and a few short rugae extending from the postscutellar suture, otherwise finely punctured, with some white hair laterally; abdominal dorsal segments with a smooth satin-like lustre, and microscopic piliferous punctures, apically with wide amber margins, pygidial plate yellowish, with many fine pale spines; ventral segments polished-black.

Legs red, fifth tarsi and pulvillus not so large as in *Sericophorus;* tarsi red, anterior comb with seven long spines; claws red; hind calcar reddish-amber; tegulae dull-amber; wings fuliginous; nervures brown, second recurrent entering middle of small triangular second cubital cell; third cubital cell very narrow; pterostigma black, large; hamuli fifteen.

Locality.—Frankston, Victoria, probably collected by the late F. Spry.

Genotype in the collection of the National Museum, Melbourne.

Allies: Not close to any other species.

Anacrucis striatula, sp. nov.

Type, female.— Length, 8 mm. approximately. Black, red legs.

Head sericeus, with appressed metallic golden hair; face excavated below the frontal rise; frons with a minute longitudinal swelling; clypeus minutely and closely punctured, with long golden hair; anterior margin with two small median teeth; supraclypeal area not defined; vertex nude; compound eyes converge only slightly above; genae with a few white hairs, dull-sericeous; labrum black; mandibulae practically black; antennae short, black, submoniliform.

Prothorax produced to an angle directed apicad, not so appressed, bracket-shaped, with white hair; tubercles black, with white hair; mesothorax sericeus, dull, close piliferous punctures, appressed black hair; scutellum large, brighter, otherwise like mesothorax; postscutellum similar; metathorax with dorsum posteriorly polished, laterally with close longitudinal striae and fine punctures; abdominal dorsal segments very smooth, many fine piliferous punctures, apical four with long golden hair; pygidial plate with long pale spines; ventral segments polished.

Legs dull-red; tarsi lightly suffused with blackish; claws red; hind calcar red; tegulae reddish-amber; wings brownish; nervures reddish-brown; second recurrent entering second cubital cell beyond the middle; third cubital cells very narrow; pterostigma blackish; hamuli thirteen.

Locality.—Jamberoo, New South Wales, 9th January, 1950, Norman W. Rodd.

Type in the collection of Norman W. Rodd. Paratype in the collection of the author. Mt. Kiera, New South Wales, 13th March, 1949, C. E. Chadwick.

Allies: Not close to any described species.

Anacrucis asperithorax, sp. nov.

Type, female.—Length, 10 mm. approximately. Black, red legs.

Head transverse, dull sericeus; face practically naked; frons with a low prominence tending to become bituberculate; clypeus of sculpture similar to frons, anterior margin with one inconspicuous low black tooth; supraclypeal area rising to a shining line that reaches the median ocellus; vertex with numerous punctures as on the rest of the head, and foveae well-marked; compound eyes with anterior margins almost parallel; genae tessellate, with a few white hairs; labrum black; anterior margin of clypeus polished; mandibulae shining black, an obscure reddish median mark; antennae black (portion of flagella missing in type).

Prothorax with a yellowish bar laterally; pleura dull-sericeus; tubercles dull-black, a fringe of ochreous hair; mesothorax dull, sericeus, practically nude, numerous shallow punctures; scutellum and postscutellum similar; the dull thorax in sharp contrast to the smooth shining abdomen; metathorax shining, with a kind of rough punctured tessellation, a longitudinal line, and vestiges of rugae basally where the cruciform structure should be; abdominal dorsal segments smooth, shining, microscopically lineate, very little hair, and a few minute piliferous punctures; caudal plate blackish, with short thick spines; margins of terga depressed; ventral segments polished.

Legs red, coxae black, anterior tarsal comb of four spines; tarsi of a slightly darker red; claws red; hind calcar reddish; tegulae reddish-amber; wings subhyaline; nervures brownish, the recurrents equally distant from the intercubiti; cells normal for the genus; pterostigma dark-brown; hamuli fourteen.

Locality.—Bolgart, Western Australia, 3rd September, 1947, leg. Rica Erickson. Female, from "nest" in ground, 4th November, 1951, leg. Rica Erickson.

Type in the collection of the author.

Allies: Approaches closely the larger more robust *A. laevigata* by the absence of striae on the dorsum. The Victorian insect has three conspicuous teeth on the clypeal margin, and a red pygidial plate.

Anacrucis cingulata, sp. nov.

Type, female.—Length, 11 mm. approximately. Black and ferruginous.

Head almost circular from the front, dull-black; face with the anterior half covered with dense appressed metallic straw-coloured hair; frons coriaceous,

with a swelling above the insertion of the scapes; clypeus ivory-coloured, anterior margin with two small black nodular teeth; supraclypeal area not defined; vertex short, dull; compound eyes converging above; genae with silvery-white fine hair; labrum reddish-amber; mandibulae yellowish-amber, reddish-black apically; antennae missing on type.

Prothorax black, a few silvery hairs; tubercles long, black, with a fringe of white hair; mesothorax black, dull, coriaceous, with dense small shallow piliferous punctures, and minute black hair; scutellum large, otherwise similar; postscutellum similar, but with white hair; epinotum dull, coriaceous, with minute piliferous punctures, posteriorly considerable appressed silvery hair; dorsum with a strong median sulcus divided by a fine carina, the transverse arm of the incisure, in the scutellar suture, with a few delicate longitudinal striae extending over the dorsum; abdominal terga black, dull, with microscopic piliferous punctures, the hind margins broadly depressed and ferruginous, apical segment red, pygidial plate light-reddish, with numerous short strong spines; sterna polished black, with narrow ferruginous margins; each tergum with several long amber setae (usual for the Sericophorine wasps).

Legs black, tibiae and hind and median femora distally ferruginous, anterior femur ferruginous with some ivory-colour; tarsi ferruginous, anterior comb with seven spines; claws simple, amber, with dark-red tips; pulvillus of moderate development; calcariae long, amber; tegulae dull-amber; wings yellowish; nervures sepia, first recurrent far distant, from the intercubitus; third cubital cell but little contracted at top; pterostigma reddish-amber; hamuli twelve or so.

Locality.—New South Wales (Milthorpe, March 1942?), leg. N. C. Lloyd.

Type in the collection of the Agricultural Department, New South Wales.

Allies: Not close to any described species, and easily separated by the ferruginous bands of the abdomen.

Anacrucis clypeata, sp. nov.

Type, female.—Length, 8 mm. approximately. Black with red legs.

Head transverse, with considerable appressed silvery hair; face closely punctured, but shining; frons with a low mamiform swelling, and a longitudinal fine line; clypeus palest-amber, with the anterior margin reflexed vertically by a deep emargination developed to a long tooth laterally, beyond which are two smaller nodules; vertex closely punctured, foveae conspicuous; compound eyes converge above; genae closely punctured, with much appressed white hair; labrum black; the glossae appears to be much longer in *Anacrucis;* mandibulae very long, amber, blackish basally and apically; antennae black, sub-filiform, apical segment compressed.

Prothorax black, with an interrupted pale-yellow line; tubercles black, with a yellow spot; mesothorax shining, numerous punctures on a smooth ground, a few whitish hairs; pleura transversely striate; scutellum finely punctured; postscutellum more closely punctured; metathorax with numerous oblique striae and punctures, and a longitudinal median line with a few short transverse striae; abdominal dorsal segments closely and finely punctate, posterior margins broadly depressed, a dusting of appressed white hair; ventral segments more shining; pygidial plate with long pallid spines.

Legs bright-red, only the coxae black; tarsi red, anterior comb of five slender spines; claws red; hind calcar red; tegulae yellowish-amber; wings subhyaline; nervures dark-brown, the recurrents equally distant from the intercubiti; cells normal; pterostigma dark-brown; hamuli twelve.

Locality.—South Yarra, January, 1950, leg. Lynette Young.

Type in the collection of the author.

Allies: Not close to any described species, but approaches *A. striatula* Raym. by the striae of the dorsum, but striae are longitudinal in this species *A. clypeata* is unique by the remarkable structure of the clypeus.

Anacrucis ferruginea, sp. nov.

Type, female.—Length, 10 mm. approximately. Black, ferruginous abdomen.

Head black, coriaceous, dull, transverse; face on anterior half with a dense covering of appressed silvery hair; frons closely punctured, with a leathery aspect; clypeus ivory-coloured, anterior margin with two minute teeth; supraclypeal area black, with a minute sulcus above; vertex coriaceous, narrowly produced; compound eyes converging above; genae microscopically punctured with white hair; labrum reddish; mandibulae amber, reddish-black apically; antennae entirely clear ferruginous, submoliform, apical segment compressed.

Prothoracic collar not appressed, black, rather large for the genus; tubercles black, with a fringe of white hair; mesothorax coriaceous, with close minute punctures, and a narrow rim or epaulette over the tegulae; scutellum and post-scutellum similar; pleura shining, with minute pilferous punctures; dorsum of metathorax with a strong longitudinal sulcus divided by a fine carina, and a fine longitudinally striato-punctate sculpture, some white hair posteriorly; abdomen ferruginous, slightly suffused on terga three and four; pygidial plate ferruginous, with pale-amber long stout spines; ventral surface polished.

Legs blackish, tibiae and knees ferruginous; tarsi ferruginous, claws amber; hind calcar pale-amber; tegulae dull-amber; wings yellowish; nervures sepia, first recurrent far distant from intercubitus; the small second cubital cell forming an equilateral triangle; pterostigma amber; hamuli thirteen.

Locality.—Wauchope, New South Wales, 1919, leg. W. Goodacre.

Type in the collection of Agricultural Department, New South Wales.

Allies: Not close to any described species, and easily known by its large size and ferruginous abdomen and legs.

Anacrucis punctuosa, sp. nov.

Type, female.—Length, 7.5 mm. approximately. Black, red legs.

Head transverse, so excessively closely punctured as to appear granular; face with much white hair on lower part, contrasting with golden hair on upper half; frons with a short line below; clypeus masked with white hair, anterior margin with two small nodular teeth; supraclypeal area not defined; vertex with ochreous hair; compound eyes only slightly converging above; genae coriaceous, with white hair; labrum dark-red; mandibulae amber, with dark margins; antennae short and black, segments broader than long.

Prothoracic collar with an interrupted yellow line; tubercles black, with amber margin; mesothorax densely and finely punctured, practically nude; scutellum similar; postscutellum with closer smaller punctures; metathorax with the dorsum defined by a fine ruga, outside of which is coarsely rugose, within it is finely punctured, with much white hair, and a fine longitudinal line; abdominal dorsal segments shining, closely punctured, with a dusting of white hair; pygidial plate brown with short spines; ventral segments polished, with amber margins.

Legs red, but coxae, trochanters and femora basally black; tarsi darker, anterior comb with seven long strong spines; claws amber; tegulae piceous, with a yellow spot; wings subhyaline; nervures sepia, the recurrents equally distant from the intercubiti; cells normal; pterostigma sepia; hamuli thirteen.

Locality.——Nedlands, Western Australia, 1st December, 1946, leg. K. R. Norris.

Type in the collection of the Entomological Division, C.S.I.R.O., Canberra, A.C.T.

Allies: Not close to any other described species, but easily known by the absence of rugae in the enclosed area of the dorsum.

It is pinned with its prey, a grey fly *Lispa cana Walk.*

The following KEY will assist students to separate the several black species in the genera *Anacrucis* and *Astaurus.*

Clypeus pale-amber 1
Yellow lateral face-marks 7
Abdomen ferruginous 8

1. Thorax shining, *A. clypeata* Raym.

Clypeus black 2

2. Thorax dull-sericeous, *A. asperithorax* Raym.

Dorsum with longitudinal striae 3

3. Face with much golden hair, *A. striatula* Raym.

Dorsum without striae 4

4. Larger, more robust insect, *A. laevigata* Raym.

Dorsum with oblique striae 5

5. Face with much silvery hair, *A. clypeata* Raym.

Dorsum with enclosed punctate area 6

6. Prothoracic collar with a yellow line, *A. punctuosa* Raym.

Dorsum with enclosed polished area 7

7. Clypeus yellow, *Astaurus hylacoides* Raym.

Prothoracic collar entirely black, abdomen red, not banded 8

8. Dorsum with enclosed striato-punctate area, *A. ferruginea* Raym.

Abdomen black, with ferruginous bands 9

9. Dorsum without an enclosed area, *A. cingulata* Raym.

Abdomen with yellow maculae 10

10. Scutellum black, *Astaurus hylacoides* Raym.

Abdomen without Maculae 11

11. Scutellum yellow, *A. tenuicornis* Raym.

THE LINK WITH THE BEES

Astaurus genus nov.

The actual bridge linking the wasps and the bees appears to be a remarkable insect taken near Portland, Victoria. It bears an astonishing resemblance to certain hylaeid males, such as *Hylaeus chrysognathus* Ckll., and approaches the genus *Phenacolletes*, which Cockerell separated from *Tachytes* only with difficulty. However, Cockerell's bee has the first recurrent nervure entering the second cubital cell. The author deems it advisable to propose a new generic name, and submits the following diagnosis.

Small polished black wasps, marked with yellow on the "face", scapes, a line on the prothoracic collar, a spot on the tubercles, and a large mark posteriorly, a fine line on the postscutellum, a macula laterally on the second abdominal tergum, and reddish-yellow tibiae and tarsi. The hair is silvery, sparse and straight, with microscopic irregularities which appear to be the elements of plumosity.

The head and genae are large, of the quadrate type of *Megachile;* no teeth on clypeus, which is not like that of the wasps, but long and bee-like; scapes inserted high on the " face "; the long filiform antennae has thirteen segments as in male bees. It is difficult to examine the mouth-parts, but there appears to be six segments in the maxillary palpus, and four in the labial palpus. The mandibles appear to be bidentate.

The collar is not appressed, and the dorsum of the epinotum is much reduced and polished, almost without sculpture, although there is an enclosed area running down posteriorly over the declivity; in the area are three or so inconspicuous striae which are undoubtedly vestiges of the cruciform structure as seen in *Anacrucis.*

There is a smooth pygidial plate, with fine pale spines, which are more or less confused with the caudal hair.

The legs are slender, and the tibiae have small weak inconspicuous spines; the pulvillus is not larger than that of bees. The fourth tarsal segment is minute, but the fifth is very long, and the large claws are simple; the strigilis of the anterior leg is short and stout, and one of the hind calcariae is likewise broad, there is a difference in the length of the pair.

The pterostigma is large, and the first recurrent nervure is received by the first cubital cell, as in all SERICOPHORINAE, but the small second cubital cell is not triangular, and with the third cubital cell, more nearly quadrate as in certain colletid bees.

The genitalia approach the form of the HYLAEIDAE, and are devoid of any vestiture; they are perhaps closest in shape to *Euryglossimorpha.*

Allies: It is evident that the coloured " face ", and the loss of the cruciform structure, could have come down through *Anacrucis* with filiform antennae; the long clypeus shows a near approach to that of typical bees, but the neuration of the wings shows affinity with *Sericophorus.* The insect is the most bee-like wasp yet described, and it is unfortunate that no female is available for study. The biology should be of singular interest.

The author is indebted to his friend, the Revd. Doctor D. M. Morris, The Monastery, Croydon, Victoria, for suggesting the name *Astaurus,* from the Greek—without a cross.

Astaurus hylaeoides gen. et. sp. nov.

Genotype, male.—Length, 7 mm. approximately. Black and yellow.

Head large, polished between the many punctures of medium size; face-marks limited to a small lunate yellow patch laterally; frons divided by a deep sulcus that reaches and encloses the median ocellus; clypeus yellow, many shallow punctures and much white hair; supraclypeal area well defined, with a yellow triangular mark; vertex with large smooth areas laterald of the ocelli; compound eyes large, bulging, diverging from the upper half; genae large, many fine punctures, a few white hairs; labrum black; mandibulae black; antennae filiform, thirteen segments, scapes yellow, stout, a black mark basally; flagellum black.

Prothorax black, not appressed, a fine yellow line dorsally; tubercles black, with a yellow dot, a large yellow mark posteriorly; mesothorax black, polished, scattered piliferous punctures, a few black but more white hairs; scutellum similar; postscutellum black, with a narrow yellow band; metathorax black, polished, laterally with scattered coarse punctures, and some white hair, a polished enclosed area shaped like a Moorish arch, with faint indications of

striae; abdominal dorsal segments black, scattered large punctures, a few white hairs; the second with a large yellow macula laterally; a short rounded pygidial plate with fine pale spines, ventral segments black, polished.

Legs black, femora apically reddish, tibiae reddish, anterior with a yellow stripe, all tibiae armed with weak spiculae; tarsi slender, yellowish, fourth very small, fifth very long, pulvillus small; claws simple, large amber basally, red apically; hind calcariae red, subequal, one broad, approaching the form of the strigilis; tegulae amber, polished; wings hyaline; nervures blackish, the first recurrent entering the large first cubital cell; the second recurrent practically meeting the second intercubitus; second and third cubital cells only slightly contracted at top; pterostigma large, blackish; hamuli nine.

Locality.—Gorae West, Victoria, 31st December, 1950, leg. A. Clifford Beauglehole.

Genotype in the collection of the author.

Allies: *Hylaeus* by the form and colour of the body; *Anacrucis* by the filiform antennae and absence of the cruciform structure; and *Sericophorus* by the neuration of the wings and the spiculose tibiae. It approaches *Phenacolletes* Ckll., where the second cell receives the first recurrent nervure.

This male is close to *A. tenuicornis* Raym. which has a yellow scutellum, black abdomen and yellow tubercles.

Taken on flowers of *Leptospermum scoparium* at 1 p.m., together with *Sericophorus chalybaeus* Sm.

Astaurus tenuicornis, sp. nov.

Type, male.—Length, 7 mm. approximately. Black and primrose-yellow.

Head black, almost circular from the front, shining; face-marks butter-yellow, laterally, subtriangular; frons smooth, a median fine sulcus, minute piliferous punctures; clypeus yellow, many pilferous punctures with white hair; supraclypeal area yellow, pyramidal; vertex of medium length, ocelli set in shallow depressions; compound eyes large, diverging on upper half; genae prominent, sculptured like the frons, a few white hairs; labrum small, oval, black; mandibulae black, bidentate, but acute; antennae black, scapes yellow in front, flagellum filiform, somewhat suffused with ferruginous.

Prothorax black, a yellow line dorsally; tubercles yellow, posteriorly a swollen yellow circular mark; mesothorax black, smooth, bright, many small piliferous punctures; scutellum and postscutellum smooth and butter-yellow; metathorax black, with a polished enclosed area, laterally some silvery hair; abdominal dorsal segments black, smooth, piliferous punctures much larger than those of thorax; ventral segments similar.

Legs black, anterior tibiae reddish in front, also the tarsi; without spiculae; tarsi black, except anterior, a few white hairs, pulvillus small; claws black, long, simple; hind calcariae subequal, black, finely serrated; tegulae black, fine punctures; wings hyaline; nervures blackish-brown, first recurrent entering first cubital cell; radial cell pointed on costa, second cubital contracted at top, third not so; pterostigma large, blackish; hamuli seven, weak.

Locality.—Lane Cove, New South Wales, 16th January, 1947, leg. Norman W. Rodd. Cheltenham, New South Wales, 13th January, 1951, leg. Norman W. Rodd.

Allies: *A. hylaeoides* Raym. which has a yellow spot on tubercles, black scutellum, two large yellow maculae on the abdomen. The two males are close, but distinct, and easily separated.

On flowers of *Angophora cordifolia*.

Biology of Sericophorus

In the summer of 1949 the author discovered a type of insect architecture which he had at first confused with the earthworks of a bee, *Paracolletes tuberculatus* Ckll., the tumuli of of which were known to be near the site. Closer investigation, however, soon revealed unmistakable differences, the aperture of the shaft was too large for the bee, and there was a ring of hard sand about the pit-mouth.

About the 1st of January, 1950, numbers of large moundlets of bright-golden sand were thrown up conspicuously on the "nature strip" bordering a road over an old sand-dune at Sandringham, Victoria. Each tumulus was composed of about 60 c. cm. of clean moist sand, and in the centre was an opening 6 mm. approximately in diameter.

The shafts were separated by about a metre, and more than 50 moundlets were counted on the 20th January. Light rain at night sometimes cemented a circlet of sand over the shaft, but later in the morning these fragile rings were thrust unbroken to one side, as though unwanted by the excavator. Heavy rain washes the moundlet entirely away.

Although the colony was kept under daily observation until 1st May, four months later, the excavators were seldom observed, for most of the digging was done as early as dawn; usually the tumuli were of quite fresh damp sand, which dried quickly.

The investigations at Sandringham over 1949–1952 were confirmed by two of the author's collaborators, Rica Erickson, at Bolgart, Western Australia, and Norman Rodd, Sydney. Their observations are printed in a narrower measure.

> "On the early morning of 11th May, after a deluge of rain, and while the ground was still very wet, I discovered two heaps of soil, about a yard apart, and just outside a door where I could keep them under almost continuous observation."
>
> "I distinguished them as "A" and "B." The mounds were not present on the evening before, and must have been thrown up during the night or about dawn. Some twenty other nests were found within the next few days."
>
> "I must remark on the peculiar arrangement of the nests. They are generally paired; eight were less than a foot apart; another eight were paired about a yard distant; two as far apart as 5 feet, and four shafts were singles 10 feet away. Do the two wasps from one shaft build nearby?"—R.E.

At Sandringham, Victoria, on the 12th February, 1950, one of the greenish-iridescent wasps with reddish legs and antennae, *S. teliferopodus,* Raym. was observed to begin her excavation. The femur of the anterior legs is the largest, and its robust development is correlated to the fossorial habits of the wasps, for most of the digging is done by the front legs: the tarsal rakes rapidly flinging the sand backwards under the abdomen. Later, the expanded fifth segment of the tarsi and the large pulvillus come into action as a broad scoop to lift out the sand.

These observation were repeated over many days at 5 a.m., even when the temperatures registered 10° C. Wasps were netted at intervals to make certain of identification. On one day a smaller wasp was observed to fly close behind another, and the two were taken. They proved to be a male and a female of the new species. The wasps have the superficial appearance of the fossorial bee *Paracolletes pictus* Raym., which has a similar bright-fulvous tip on the abdomen. Other wasps are most active on bright hot days, but *Sericophorus* prefers the cool hours of early morning.

> "The wasps emerged from the shafts at about 10 a.m., and were absent for long periods, perhaps feeding, and the only blossoms available were those of "Wandoo, *Eucalyptus redunca,* and a red *Epacris,* but I have never seen the wasps on the latter species."—R.E.

The species collected by Rica Erickson, in Western Australia, proved to be new, *S. sydneyi* Raym.

The smaller black species, *S. pescotti* Raym., was frequently observed at Sandringham, Victoria, on very hot days in February, searching for suitable home sites in compacted sand, but she appears to be rather captious, for after a frenzied raking of the sand for a minute or two, she dashes off to try elsewhere. She hunts for small flies, but the actual species sought for prey has not been determined. These traits have been observed in *S. relucens* Sm. and the two subspecies.

The fact that the wasps work early and unobstrusively undoubtedly accounts for their comparative rarity in collections, but it is remarkable that such large colonies should have eluded observation for so many years. The summers of 1950–1951 will be remembered for record precipitation, with a humid atmosphere, and repeated flooding of wide areas in Eastern Australia; perhaps such conditions favour the distribution of the species.

"I think the season must be just beginning for the wasps, that is, after the rains, for now heaps of soil are beginning to show in many places in the garden. Apparently the dampness of the garden made it an oasis for the insects. I had not noticed them in other years."—R.E.

Architecture

Much of the wasp's life is spent underground, excavating a shaft and two cells in sand, but just how many shafts are constructed by one female could not be ascertained, although the digging is easy, and very probably six or more are excavated. The wasp appears to take little time to capture sufficient prey for one cell.

The bright-golden sand, stained by oxide of iron, stands out in sharp contrast to the dark humus of the top-soil, but heavy rain often washes it entirely away, so that the position of the shafts cannot then be identified. The site of the colony is on the summit of a small hill, and no water could lie about, and it was observed that many of the wasps dug shafts between the pitchers of the street channels; no doubt attracted by the warmth of the dark basaltic cubes when heated by the sun. It was noticed that as autumn approached the stones were neglected. In May, the temperature of the sand near the cells registered 12° C. Work had then ceased for the season.

The entrances to the shafts are usually masked by much loose sand, but the female has no difficulty in returning with certainty to her own home, and burrows quickly down out of sight. The remarkable pulvillus, or large webbed structure between the two short claws, together with the expanded fifth tarsal segment, act as a capacious "paw", with which the sand is scooped up with the utmost efficiency. At the base of the shaft there is a X-shaped branch, with a cell at the end of each gallery, which is about 7 cm. in length. The main shaft, which is not quite vertical, goes down for about 37 cm. When the shaft is open the wasp is away hunting; when closed, she is at home resting.

"I saw a wasp 'scouting' over the ground as though searching for a suitable site. The shaft appears to go straight down, but I watched one wasp that preferred to enter her shaft under a fallen gumleaf, where the pellets of soil had to be compressed to form a horizontal tunnel. This method entailed a lot of extra labour in cramped conditions."

> "I dug out one shaft, which had a diameter of $\frac{1}{8}$ inch, and descended perpendicularly for 5 inches; it then deviated round some pebbles, and then went down again for 3 inches. I found the first cavity to the west of the shaft at 9 inches down, and the second, on the east, at $8\frac{1}{2}$ inches. Both chambers were pear-shaped, and so far as I could see, without any lining."—R.E.

Completed shafts were again investigated at Sandringham, on 22nd April, 1950-51-52, and careful examination showed a few threads of silk woven over the cell-wall, forming a loose net to enclose the bodies of the prey in a compact mass. Several full-grown larvae were taken out of the cells, and one had a black mass resting on the ventral surface within reach of the mandibles, which made feeble efforts to eat a little more of the substance. The many black setae scattered over the larva appeared to have come from the bodies of flies.

In the base of the cocoon there is cemented a thin black disc, and this appears to be the excremental debris ejected by the larva soon after the mesenteron is joined to the proctodeum. The colour is no doubt due to the melanin in the integument of the flies. The inner surface is dusted with white granules, probably urates, calcium carbonate, phosphates, &c.

Larval Food

Some of the abandoned cells held the disjecta membra of blow-flies, and several chambers contained twelve heads, twelve thoraces, 48 wings and numerous legs. The flies were larger than those collected by Rica Erickson, and are certainly the common golden-haired blow-fly, *Neopollenia stygia* Fabr. [1]The wasp from Western Australia is smaller (7 mm. in length) than the Sandringham species (10 mm. in length), consequently the prey is smaller; the fly is *Musca vetusstissima* Walk[2]. (The prey sought in the other States is given on p. 79).

The western fly is 5 mm. in length, black and hairy, with many strong bristles. It is a very numerous species, and pesters people by alighting in numbers on the back, and thus is frequently carried into the house. Both the eastern and the western flies are well-known pest species.

Like the western species *S. sydneyi*, the Sandringham wasp, *S. teliferopodus*, does most of the excavating just before dawn, so that the observer must be in the field before 6 a.m. The hunting is, however, done much earlier, and the period of greatest activity

1. Syn. *Anastellorhina stygia* (Fabr.)
2. Syn. *Musca pumila* Maqr.

is between 5 a.m. and 6 a.m., and on the 3rd of December, 1950, females were returning with a fly every three minutes. They remained below for about two minutes. They then re-emerged without rest to resume their hunting.

There is no hesitation in the female's return to the shaft; she just dives headlong down with her prey, hence the necessity for a large entrance. The author has taken a number of laden females to examine the prey, and in every case the fly appeared to be quite dead.

All the flies examined have been males, and the author concludes that female blow-flies are not taken by the wasps. The predator's preference for male victims is not difficult to understand. The death of the mother fly does not necessarily involve the death of her progeny, and should a mother be injured, the lively young maggots are extruded in numbers[1]. Therefor, should a gravid female fly be taken below to the cells, the young maggots would certainly destroy the wasp's larva before it could destroy them.

The author and his assistants have on many occasions captured male blow-flies entering in and departing from the shafts of the wasps, and this fact poses the question of whether or not the dangerous attraction for the male flies lies in a chemotropism—the scent of the wasps may be an irresistible lure. On the other hand, it may be merely a case of " like attracts like "—the odour of the flies stored in the base of the shaft.

Larval Development

The elongate cylindrical egg measures 3 mm. at the long axis and 1.3 mm. at the short, so that it is proportionately much longer than the eggs of bees. Like most of the eggs of the *Hymenoptera*, it is glued into place by a secretion from glands at the apex of the female abdomen.

The egg is attached to the ventral surface of the thorax, close to the coxa of the anterior left leg, and on hatching, the larva attacks the thin chitin at the articulation for its first mouthful, perhaps by sucking, but later, when its mandibulae are more strongly chitinized; the harder legs and body are eaten.

Any vigorous movement of the fly's legs would certainly dislodge the egg, but the sting renders the prey utterly inert, and

1. Female blow-flies, netted in the vicinity of the colony on 10th December, 1950, each voided more than 60 vigorous maggots when held with a forceps on a glass slip. On dissecting a gravid female, 62 well-grown maggots were taken from her abdomen. This number would rapidly reduce the larva of the wasp to mere gravy.

there is no struggle. The flies are not required to survive long enough for all to be consumed alive; they are killed outright as is the habit of certain bembecid wasps.

The first damage was observed about the trochanters and the base of the femur of the fly, and it was evident that the soft chitin of the articulation offers least resistance to the initial attempts to eat. Dr. F. X. Williams (1919) observed a similar preference and habit in a sphecid wasp in the Philippine islands[1].

The period for the incubation of the egg appears to range between four and six days, and is no doubt governed by soil temperature, and this variation was also recorded in other genera by Williams.

Just how long the larva takes to consume its twelve or so flies could not be accurately ascertained, but it is somewhere about twelve or fourteen days; not a morsal is left unconsumed to contaminate the amber-coloured silky cocoon.

Temperature and Humidity

The temperature of the sand surrounding the cells at the base of the shaft was recorded at regular intervals in an endeavour to determine the optimum conditions for the development of sericophorine larvae.

What few experiments have been made with other insects and recorded by authors seem to indicate that insect development is arrested in the zone between 13.8° and 4.4° C.; the fatal zone up between 35° and the maximum 60° C.; the effective zone being between 13.5° and 35° C. Imms (1931) states that grain-weevils held at between 16° and 27.7° C. required 10 per cent. humidity for their normal development.

It was, therefor, of interest to observe the progress of the sericophorine larvae in the conditions described below, for there was a total absence of the fungal growths that usually defeat attempts to rear the larvae of fossorial wasps and bees in laboratory conditions. The larvae appear to develop better at the lower temperatures.

The sericophorine cells were built at a depth of 37 cm., and at that level a wooden rod was thrust into the moist sand on the vertical " face " of the excavation. A thermometer was inserted in the resulting cavity, and a reading was taken at noon on the dates specified in the table.

1. "The young grub—*Cratolarra pitamaica* Rohver—sucks out its victim's juices, but later . . . devours also the harder parts of its prey's anatomy."

Cocoons which had been dug up on the 15th of April were laid between cotton-wool, and placed in a fibre box measuring 12 cm. by 12 cm. by 5 cm.; that is, the box had a capacity of approximately 720 c. cm. The cover fitted neatly but not air-tight, and the temperature of the interior of the box was maintained, within a degree or two, of that of the soil.

All the female wasps collected by the author at the new " Site 3 ", during the first half of December, 1950, were smaller, measuring only 10 mm. in length against the 12 mm. of the typical form, yet there is little doubt that every one emerged at and emigrated from the parent colony.

These smaller females are bluer in colour, and the red portions are darker, but a critical study of mounted preparations showed no structural differences, except that of size; they are also less hairy. The uniformity of the females suggests a common law rather than mere chance. This condition was present also in the laboratory specimens.

The differences could be due to any one of several factors[1]. One—a detrimental change in the temperature of the soil during a critical period in the development of the larvae. Two—An alteration of the moisture content of the soil. Three—Quantitative and qualitative factors in nutrition. Four—Genetical inheritance. Any one of these factors can affect the size of adult bees. It is difficult to see the incidence of genetical inheritance on the problem because of the numbers of unrelated solitary mothers comprising the parent colony.

Whatever the causal factor might be the taxonomist, unfamiliar with the phenomenon in the field, would almost certainly refer the smaller females to a variety, or even a subspecies of *S. teliferopodus* Rayn.

A small female. 7.5 mm. approximately, very close to *S. sydneyi* Rayn. was received from Bolgart, Western Australia. It is separated from the normal form by two short stripes of white hair on the mesothorax; two large clypeal teeth, and other trifling morphological differences. This form may be to *S. sydneyi* what the smaller Sandringham forms are to *S. teliferopodus*. Surprisingly, parallel forms of *S. cliffordi* were received also from Gorae West, Victoria. Whether or not these smaller wasps could be due to genetical or nutritional factors was not determined, and until more is known about their origin, the author has referred them to the species mentioned.

1. The pupal stages of these small females were passed during a period of intense sun-spot activity which disrupted radio communications during the latter half of November and the early half of December, 1950. The author is not competent to offer any more than the mere record of the facts.

TABLE OF DEVELOPMENT

Sericophorus teliferopodus

15th April, 1950.—Completed cocoons removed from a depth of 37 cm. in sand.
Eggs laid about 1st April.—Larvae do not exhibit any special characters; pale-gray in colour.

Barometer (Inches).	Shade Temperature.	Temperature of Soil.	Moisture Content.	Temperature of Larvae.	Relative Humidity.
30·299	15·0	12·0	25	12·0	28
1st June.—Larvae had changed from pale-gray to pale-ivory colour.					
29·942	16·5	12·0	20	12·5	29
15th June.—Larvae showing small lateral swellings.					
..	..	12·0	22	12·0	30
1st July.—Larvae unchanged.					
30·204	12·0	12·0	20	12·5	31
15th July.—Larvae unchanged.					
30·512	9·0	12·0	20	12·0	30
1st August.—Larvae showing small lateral buds.					
29·804	16·8	12·0	20	12·5	30
15th August.—Larvae showing large lateral buds.					
30·456	15·2	12·0	18	12·5	30
1st September.—Larvae with a line of eight large dorsal tubercles.					
29·784	12·2	13·0	18	13·5	30
15th September.—Thoracic tubercles now developed to transverse ridges.					
30·60	13·0	13·5	20	13·5	30
1st October.—Larvae, with eight large pearly lateral buds, contracted dorsally.					
30·80	16·0	15·3	16	16·0	32
15th October.—Larvae 5·5 mm. in length, oval in dorsal view.					
30·8	16·0	16·0	15	16·0	33
1st November.—Larvae expanded dorsally.					
29·61	17·5	16·5	19	17·0	37
15th November.—Larvae conspicuously convex dorsally, with a longitudinal fine dark line.					
29·79	..	17·5	10	16·5	37
23rd November.—Larval segments deeply defined. Skin somewhat flaccid.					
..	32·0	26·0 at noon, receding to 20 at midnight			98
(An uncomfortable heat-wave passed over the State bringing abnormal conditions). 30th November.—At 3 p.m. the first of the shafts in the field were reopened. 1st December.—Larvae in laboratory unchanged.					
29·90	17·0	20·0	7	22·0	89

(On 3, 4, 5, and 6th of December, 1950, another distressing heat-wave passed over the State, with the shade temperature reading 39° C. The temperature of the larvae in the laboratory rose to 30° C. at noon and receded to 20° C. at midnight. In the field there were, by actual count, over 100 new shafts open on three sites.)

15th December.—Larva often draws in and then extrudes the translucent apical segment; incipient thoracic segments more defined; large oenocytes show as opaque white cells on translucent body.

29·80	24·0	23·0	5	19·5	89

(On 16, 17, 18, 19th December, 1950.—Yet a third heat-wave swept the State, with shade temperatures reaching 38° C. A violent change on the 20th sent the temperature down to 13° C. and increased the author's difficulties. In the field every shaft was closed, and excavation was not resumed until three days later.)

TABLE OF DEVELOPMENT—*continued.*

Sericophorus teliferopodus—continued.

20th December.—Larvae unchanged.

In the field, the first series of shafts were closing, but at 4 p.m. all tumuli were washed away by a storm.

23rd December.—Larvae in laboratory unchanged.

Many new shafts begun after three days of inactivity.

27th–29th December.—Larvae unchanged.

A fourth wave of heat swept the State; on the 29th a violent storm washed away all tumuli

1st January, 1951.—Larvae unchanged.

In the field, many new excavations and fresh tumuli.

8th–12th January.—Larvae changing.

A fifth wave of heat swept the State, with shade temperatures recording 41° C. A violent storm on the 12th washed away all tumuli.

15th January.—Larvae approaching pupal stage.

Temperature of box crept up to 25° C. at noon, receding to 20° C. at midnight. In the field, many new shafts.

1st February.—Larvae in laboratory changed to pupae.

Temperature of box 29° C. Relative humidity 100 per cent. on 7th February all shafts of third brood closed.

15th February.—Pupa in laboratory almost fully developed, and emerged a few days later. Temperature of box 29° C. Relative humidity 100 per cent.

1st March.—One pupa dead in cocoon.

Temperature of soil 24° C. of box 23° C. Relative humidity 80 per cent.

15th March.—All larvae in laboratory changed to developed pupae.

Temperature of soil 23° C., of box 20·5° C. Relative humidity 80 per cent.

(The summer of 1950–51 was the hottest ever recorded for Melbourne, Victoria, with high humidity. In Sydney, New South Wales, there was the phenomenal precipitation (1949–50) of 151 inches. In the spring of 1951, light falls of snow fell on five occasions during the 9th August at Sandringham: This was unprecedented in the history of the "village". The temperature fell to 2° C. and Melbourne experienced its heaviest fall of snow for 102 years. Snow falls are exceedingly rare on the shores of Port Phillip Bay in Victoria. It should be observed that such remarkable circumstances may have had an acute incidence on this record.) All shafts in the field were closed on 1st May, 1950, but one female was digging the second cell on 13th May, 1951.

Behaviour of the Individual

"The wasp grips her captive between her hind legs, with the tip of her abdomen curved under and forward, as though to support the prey. The fly is carried with its legs uppermost, and the head forward; the wasp walking on four legs, sometimes on five, and occasionally on six."

"About a dozen or thirteen flies are stored in each chamber, and the wasp's egg, like an elongated jelly-bean, is deposited on the breast of one of the flies—the first captured? When I caught a wasp with her fly, there was a moment of frenzied struggling before the prey was dropped; the wasp then departed to hunt for another. This one seemed to be a very teachable individual."—R.E.

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1. At Cheltenham, New South Wales, December, 1950, the moisture content of punky wood, in which a colony of *Halictus peraustralis* Ckll. was studied by the author, was found by Norman Rodd to be 72·5 per cent.
2. Frequent and unexpected "cuts" in the supply of coal-gas and electrical energy during the entire period of larval development, reduced the control of temperatures to primitive and much less efficient devices. See note on Graph, Text, fig. 7.

It is probable that the short curved sting of these wasps is used to impale the victim, for this remarkable habit had also been observed in America by Phil. Rau (1918) in his studies of *Paranothyreus,* a species of wasp which stocks its cells with flies. The large salivarium is not conspicuous on the glossa, nor are the ducts of the pharyngeal glands on the pharyngeal plate, and it is improbable that any glandular secretion is added to the animal food of the larvae.

> " The wasps were watched very closely, and to make sure they did not slip in or come out without being recorded, I placed glass tumblers over the shafts. One unexpected angle of the tumbler method developed into an experiment that tested the powers of a female to orientate herself."
>
> " For convenience in observing, I wore a pair of grey-coloured ' slacks ', and stood on the west side of ' A ' shaft, and near enough to lift the tumbler as required to permit the wasp to enter and depart. Evidently, the ' slacks ' were regarded as land-marks, for when I moved over to the west of ' B ', the returning wasp immediately darted down the strange shaft with her prey."
>
> " I could make no mistake about the wasp, because the tumulus of ' B ' had been flattened by a wheel of an auto-truck some days previously, and our cat had pounced on the wasp, which was probably killed, since it did not return to the nest."
>
> " Further proof of deception is provided by the fact that, wherever I moved, the returning wasp invariably flew to me, and orientated herself by the legs of the grey ' slacks.' When other watchers, dressed differently, took up a position to observe, the wasp still followed me, searching for a nest which did not exist. A change of clothes undoubtedly confused her, and she mistrusted strange observers until they, too, donned grey ' slacks '."
>
> " The wasps emerge about 10 a.m., and go abroad, perhaps to love and feast; they return to do a little excavating about 1 p.m. and then begin a very busy hunting period for about two hours or more, after which they remain below till next day, when the programme is repeated. The time-table below was compiled on the 13th May, 1950."—R.E.

There is little doubt that the interval between the cessation of work on the afternoon, and emergence on the following morning, is spent in excavating and draping the second cell, and preparing

it for the reception of the victims of the next hunting. The time-table is almost a duplicate of that for the 12th May, and since it is a characteristic one, and covers the whole of her hunting period for one day, is given in full.

13th May, 1950, at dawn—

Fresh soil had been pushed up overnight into a tumulus.

11.10 a.m. Wasp emerged; orientated site.
11.12 a.m. Arr. 1st fly.
11.18 a.m. Dept.
11.22 a.m. Arr. 2nd fly.
11.26 a.m. Dept.
11.30 a.m. Arr. 3rd fly.
11.35 a.m. Dept.
11.36 a.m. Arr. 4th fly.
11.40 a.m. Dept.
11.45 a.m. Arr. 5th fly.
11.47 a.m. Dept.
11.48 a.m. Arr. 6th fly.
11.50 a.m. Dept.
11.51 a.m. Arr. 7th fly.
11.52½ a.m. Dept.
11.53 a.m. Arr. walked about.
11.54 a.m. Dept.
11.55 a.m. Arr. 8th fly.
11.57 a.m. Dept.
12 noon. Arr. 9th fly.
12.2 p.m. Dept.
12.8 p.m. Arr. 10th fly.
12.17 p.m. Dept.
12.20 p.m. Arr. 11th fly.
12.23 p.m. Dept. absent for a long period.

1 p.m. Wasp arrived and entered shaft. Shortly after she began to excavate again, pushing up a few pellets to close the entrance. The wasp must have remained below during the rest of the afternoon, for a glass tumbler was placed over the hole.

14th May. The mound of soil was unchanged up to 10 a.m. She then made a hole through the mound as though for an exit, but she did not flutter up into the glass and remained below.

10.40 a.m. The wasp now appeared, and began filling in the shaft by standing in it, and drawing in the pellets of soil from the mound with her front legs until only the outer shell was left, and when it collapsed, she continued drawing in the pellets until only a small ring of soil was left round the shaft."—R.E.

Many larvae were fully-developed by the 22nd April, and they measured 10 mm. in length; the colour being pale bluish-grey, with a dark dorsal stripe; the very small head is creamy-white in contrast, and the mandibles strongly chitinized, and capable of chewing firm material. Large numbers of pale oenocytes are conspicuous in the body-juices. All the larvae are quite white after the mesenteron has been evacuated, and are fully-developed by the end of April; imaginal buds (histoblasts) are conspicuous by the end of May.

The two cells are horizontal, and the larvae are encased in thin oval cocoons woven of amber-coloured silk, covered on the exterior with a coating of clean golden sand, which had been incorporated during the weaving. The threads of the inner silk run round the cocoon in a close spiral. The completed shafts are filled for their entire depth with clean sand.

> " Only a ' shell ' is left standing over the shaft, which the wasp closes by standing vertically in the shaft and reaching for the grains with her forelegs; she presses them down with her hind pair, like a man stamping down wool in a bale."—R.E.

In Victoria the activities of the females were ended by the 1st May, but the season is much later in Western Australia. Mating takes place over the colony; at least smaller wasps were seen to pursue closely the larger ones. The males are similar to the females, but much smaller, and the apical segment of the flagellum is modified.

The females, it would seem, mate only once. Norman W. Rodd observed the behaviour of the males at a colony which he found in New South Wales. The species proved to be *S. viridis* subsp. *roddi*, and his account is appended.

> " In late December, 1950, at Tallong (elevation approximately 2,000 feet.), I observed a rather scattered colony of the wasps. A dozen or more of the shafts were located in a 50-yard length along a bush-track; some of the entrances were on level ground, but others were in the sides of ruts made by tractor-wheels."
>
> " All were in fine red volcanic soil, which was particularly moist, and apparently had been for the greater part under water, owing to the prolonged wet weather experienced in New South Wales during the year."
>
> " I spent several hours watching the shafts, and saw a few small wasps making exploratory flights over the surface of the ground, before forcing an entrance down the shafts, all of which were closed with loose red soil."
>
> " None of the wasps was seen to carry any prey, and on capturing a number, I was surprised to discover that they were all males. I am forwarding several of these for your investigation."
>
> " The females probably had not yet commenced to hunt, but were working down below preparing the cells. The fact that the males were repeatedly seen to enter the shafts would seem to indicate that mating takes place below ground."

"Unfortunately, my time was limited, and I was unable to dig out any galleries to confirm this. If the nests could be examined at a later date, say in two weeks time, I believe more reliable information would be obtained."—N.R.

It would appear, too, that the females of *S. sydneyi* Raym. at least, endeavour to establish "territorial rights", as it were, over specially desirable home-sites, and this behaviour has been observed in other Hymenoptera. Wasps, bees and ants have strong instincts regarding property rights, and will maintain a violent defence of the home site against all trespassers.

Rica Erickson sends the following observation:—

"The female wasps are quite pugnacious to other insects. On a patch of damp ground, which seemed to hold an attraction for wasp after wasp, one female amused me with her strenuous endeavours to chase other insects away. Even the larger honey-bees were not allowed to loiter. Certainly they did not appear to be greatly frightened by the wasp, but she nevertheless kept them moving. The wasp seemed much too small to be "bossing" other insects so effectively, but by flying at the intruders with savage gestures, she ultimately succeeded in scattering and driving them away."

"The sexes seem to emerge in late evening or early morning. Four of the shafts opened within twenty minutes, but I placed a glass over the fourth, and obtained a male and a female from another shaft."

"The natal shafts are not deserted immediately, for the sexes may return to rest in them for a while, but the females soon commence the new digging, and thereafter the sexes apparently rest in the new shaft, at least, that is what I conclude from my own observations."

"I did notice that when I captured a wasp emerging from her natal shaft, and enclosed her in a glass tube, she did not survive the imprisonment for more than an hour or two.[1]"

---

1. The concluding observation has been confirmed by the author in many other Hymenoptera. The irresistible urge to emerge and fly cannot be defeated, for death soon follows delay. An exception is found in certain halictine bees, where the virgins are loath to leave, and simply enlarge the natal chambers to rear their brood. In the absence of the sexual urge there is no departure from the parental home; it is, therefor, the dominant factor in the departure of insects after emergence from the cell. This is demonstrated by the worker-bees of the hive, for all remain in the colony.

The laden females of *S. teliferopodus* fly rather slowly, and not on a level keel, but with the head highest, as though the "stowing of the cargo had made the ship ride low down at the stern."

When captured in the net, the females maintain a loud excited buzzing, and make strong endeavours to force a way through the meshes, levering determinedly with the calcariae and spines against the threads as though to cut through them.

When a female wasp and a female blow-fly were enclosed together in a glass vessel, the two insects appeared to avoid each other. However, the two insects were imprisoned together for twelve hours without either sustaining any damage.

When two female wasps were imprisoned in the jar, they immediately engaged each other, and grappling frenziedly together formed a tight ball[1]. In the clinch, each appeared to be seeking a weak spot in the other's armour to deliver the coup-de-grâce. However, after a second or two, they recognized the character of the opponent, and breaking away, offered no further attack.

Rica Erickson saw two wasps depart from the shafts "A" and "B" when they were first observed, but only one female returned to perform the work of excavating and provisioning each nest. The observer was not certain that "A" and "B" were the natal shafts, but very probably they were; there are two cells to each shaft, and the author has taken a large and a small cocoon, a female and a male, from one nest. The larvae are over-wintered in the cells; and the imagines emerge in the following summer.

> "On taking out the closely compacted cluster of flies from one chamber, the wasp larvae on one fly was at first making what appeared to be sucking movements while it mouthed a leg, and I wondered whether it would have moved on to the body of the next fly had I not frustrated it by dispersing the other victims. There seemed to be more than one day difference in the age of the larvae from the two cells in the one shaft."—R.E.

1. (The hunting of the wasps appears to be correlated to the mating habits of the blow-flies. On certain mornings, at 5 a.m., the author observed numbers of flies copulating, and the wasps busily returning with captured males. On other mornings, when the flies were not mating, the wasps visited gum-blossoms, which were secreting nectar copiously. When the flies were mating, the blossoms lacked nectar. Very subtle relationships are indicated, but a heat-wave dominated the State of Victoria on December 2, 3, 4, 5, 6, 7, and the atmospheric conditions were abnormal.)

In several of the cells investigated by the author at Sandringham there was a similar compact mass of heads, thoraces, and abdominal terga, but all were empty, as though they had been sucked dry. It would seem that at first the larval wasp sucks the juices from the prey, but after the mandibles are chitinized, it is then able to attack the harder portions, for there are no disjecta membra in the cells with the cocoons. Where the chitinous " shells " were present there was, of course, no larval wasp, and it was postulated that it had been consumed by a parasitic mutillid which was taken from several other cells.

Parasites

The mutillid parasites were most in evidence during March and April, and they are of very conspicuous colours not altogether unlike those of the wasp, for the head is black, the thorax red like the legs, and the abdomen a lustrous purple. A small black male caught flying over the site is probably the other sex, for the two are often quite unlike in this genus. Another small mutillid was present, but was not determined.

A small ant of similar size and colour—identified by John Clark as *Melophorus iridescens* Emery, — was frequently observed ranging about the moundlets, but its incidence on the biology of the wasp is unknown. Rica Erickson also mentions an ant about the nests.

The author could find no record of the blue-spotted parasitic bee *Crocisa lamprosoma* Rad., from any locality south of the Dividing Range, for its known hosts, anthophorid bees, are rare in Southern Victoria. He was, therefore, astonished on Monday, 30th January, to net a robust female busily investigating the shafts of the wasps; the temperature was 33° C. It is suggested that the *Crocisa* was searching for shafts of *Anthophorae,* but an assistant says she saw the parasitic bee emerge from a shaft. A month later the cell was excavated, but only a mutillid was in occupation. Collembolans, *Arrhopalites?* are sometimes present in old cells.

A large black bombyliid fly, in the genus *Systoechus,* also dawdles among the shafts, and there is little doubt that she is parasitic; there is some evidence that she utilizes the captives of a quite unrelated wasp, for the author found a number of her larvae on a paralyzed spider. These flies frequent garden flowers for a sip of nectar.

A pompilid wasp of grayish-black colour, with orange-coloured legs and antennae and clouded wings, will descend the open shafts of the wasps, and excavates at the base a crude cell which she stocks with spiders. An arachnid was taken out of one shaft with the young pompilid larva just about to commence its meal.

A small fly, identified by Dr. C. H. Curran as probably *Hylemya urbana* Malloch, also wandered about the entrances.

A minute acarine mite was removed with some pollen-grains from one wasp, and in April, 1951, another mite was found in a cocoon containing a dead wasp.

It was identified by Mr. H. Womersley as *Tyrophagus putrescentiae* Schk[1].

NOTES ON A SPECIES IN NEW SOUTH WALES

Sericophorus viridis roddi, Raym.

Observations on the subspecies were carried out by Norman W. Rodd on the 14th January, 1951, at Cheltenham, 15 or so miles north of Sydney.

> "The holes which I located were in sandy soil, or in sandy ground containing a very small proportion of clay, but really heavy ground is avoided."
>
> "The first shafts were more or less what I would call 'solitary'; i.e. no other shaft was in the near vicinity. The second shaft was one of a group of four, occurring over a few yards square."
>
> "Each shaft was surrounded by a fairly substantial 'volcano' of soil. The shafts descend more or less vertically to a maximum depth of 7 to 8 inches, and are quite unlined. The cells were about 5 inches to 6½ inches down, and they too were free from any lining."
>
> "In No. 1 shaft I found five separate cells disposed around the main shaft at various levels, and separated from it by short tunnels 1 to 2 inches in length, but these had been filled with sand. The cells had a diameter of approximately 10 millimetres and were pear-shaped."
>
> "I took a number of flies from each cell, and they appear to be of different species and families, and, in every case, the larvae were in early stages, attacking the fly on the ventral junction of the head and the thorax. The contents of the cells were sent to you in the hope that the wasp-larvae survived the journey."—N.R.

The contents of the five cells arrived during another heat-wave in Victoria; all the wasp larvae had been de-hydrated, and were mere mummies. The flies, too, were dead, but in good condition for identification. One fly in each cell had been attacked near the articulation of the anterior coxal segment, and apparently that is the position favoured by the genus *Sericophorus*.

1. A number of mites taken from another fossorial wasp, *Bembex* sp., proved to be a species of *Pymephorus*, a genus closely allied to *Pediculoides ventricosus*, the chaff-itch mite.

The author made a microscopic examination of all the prey, and confirmed his observations on *S. teliferopodus* Raym.—only male flies are captured to store the cells. The victims appear to be killed outright, but if they are not, then life is so reduced that it cannot be detected.

It would appear that the largest number of flies, (7) is provided for female larvae, and the smaller number (4 or 5) yields sufficient sustenance for the males, thus conforming to a general law of the HYMENOPTERA. It will be observed that all the flies are well-known pest species in the family MUSCIDAE.

Although the morphological characters of the adults are often extremely critical, it is interesting to discover that the habits, and the " prey ", are widely divergent in wasps so nearly alike morphologically as *S. viridis roddi* and *S. teliferopodus*. This phenomenon amply justifies the critical determinations of the taxonomist. It is probable that *roddi* will later be raised to full specific rank when the biology of *S. viridis* is known.

SHAFT No. 1.

Cell

A. Seven small metallic-green males, *Lucilia argyricephala* Macq.

B. Seven small metallic-green males, *L. argyricephala.*

C. Five small metallic-green males, *L. argyricephala.*

D. Two green males, *Luc. arg.* Two greyish flies, *Musca convexifrons* Thoms. and *Calliphora tibialis.*

E. Four green males, *Lucilia argyricephala.*

SHAFT No. 2.

A. Seven small brownish-grey blow-flies, *Calliphora tibialis.*

B. Five small brownish-grey flies. Four *Caliphora tibialis,* 1 *Musca vetusstissima.*

Froggatt 1917 described a wasp, 8.5 mm. in length, *Stizus turneri* Frogg., which attacks the small bush-fly, *Musca corvina.* " The wasp flattens its wings, and then jumps on the prey, killing it in one act." He names another species of *Stizus,* and also a species of *Nysson*, as preying on flies, and thought that the prey was taken down into earthern burrows, although he did not discover the nests.

The second wasp attacked another fly, *Pychosoma* (*Calliphora*) *varipes,* on the backs of sheep. The same author relates that sheep-farmers, in the Riverina district of New South Wales, had reported to him that the wasps had been observed to attack and carry off the much larger blow-flies, but Froggatt doubted this, and suggested that such small wasps would be unequal to the task.

It is probable that the insect observed by the pastoralists was a much larger and stronger *Sericophorus* attacking the blowflies, but as Froggatt did not know the habits and the prey of *Sericophorus,* he apparently concluded that the pastoralists had been mistaken.

The robust females, 23 in number, taken from a blow-fly trap on Black Mountain, Canberra, A.C.T., by Doctor I. J. Mackerras, C.S.I.R.O., all proved to be in the subspecies *S. relucens nigricornis*, but there is no information as to which species of fly, if any, were in the trap, or whether the wasps had been enticed into the trap by the presence of the prey.

The only record of the prey taken by *Anacrucis* is attached to the type of *A. punctuosa* Raym. The wasp had been pinned alongside a small tachinid fly, and the legend read—"Wasp with prey." It is thus evident that fly-catching is also a habit of species in this genus.

Economic Value

These iridescent wasps are of considerable economic importance, since they hunt and destroy numbers of blow-flies which are serious enemies of man and his domestic animals.

The largest species, *S. teliferopodus,* Raym., at Sandringham, preys on the common golden-haired blow-fly, and since a dozen or more flies are required to stock a single cell, the wasp colony of 50 shafts, each with two cells, almost certainly destroyed more than 1,200 blow-flies in a day or two. Less than three weeks are spent in excavating and provisioning one shaft with its two cells.

It is probable that each female excavates several shafts during the season, that is, she could provision six or more but even at the lowest figure, she would require 144 flies for her progeny, and the entire colony of 50 or more wasps the astonishing total of 7,200 blow-flies.

In Western Australia, Rica Erickson counted twelve bush-flies as they were being taken down a shaft by *S. sydneyi,* Raym. Later, she took two more from the same wasp, which was observed to drop yet another victim, so that the observed number carried by one wasp was fifteen flies.

However, the circumstances in that case were abnormal, but even at the conservative estimate of twelve flies for each cell, a colony of the wasps is a valuable factor in the biological control of blow-flies in Australia.

The study of the pollen-grains adhering to the mouth-parts demonstrated that the insects favour the Myrtaceous plants, for only one or two females had visited species outside that family. The wasps apparently obtain sufficient pollen and nectar for a meal from one plant, and only occasionally were two kinds of grains present on one wasp. The females confine themselves to certain plants for that reason, but should the supply available be insufficient for their immediate needs, they then seek another myrtle.

It has been contended that since both the wasps and the flies are indigenous species, a delicate balance of nature has been established over aeons of time, consequently, the biologist can do little to increase the wasp populations.

But that is not the position facing the pastoral industry in Australia to-day. The introduction of the sheep, and subsequent increase in the numbers of flocks, has brought about a major

dislocation of the balance of nature by providing an unlimited supply of food for the flies, which rapidly increased to disastrous proportions.

The sericophorine wasps were probably the chief agents in the biological control of the blow-fly during the era of the emu and the kangaroo. Then, suddenly, the wasps were overwhelmed by sheer weight of numbers, and the stable balance of nature was destroyed.

It will never be restored until the wasp population is sufficiently numerous to re-establish its control of the flies. The author is convinced that such a desirable objective could be attained by implementing the following policy

A. Establish small breeding areas or sanctuaries (an acre or so) in each district.

B. The introduction to, or " seeding " of the most valuable species in such areas.

C. Protection of the areas from destructive agents, such as fire and flood, earth-works and the cultivation of the soil, the exclusion of animals which could destroy the shafts of the wasps, the broadcasting of poisons. (The remarkable pulvilli on the tarsi of sericophorine wasps render them singularly susceptible to poisons such as D.D.T., which rely on contact with the feet of insects for their efficacy. The Hymenoptera are all susceptible.

D. The cultivation in such areas of the botanical species favoured by the wasps.

It is hardly necessary to stress the fact that no fears need arise regarding the increased numbers of the wasps, for there is no danger to man or any of his animals, either from individual insects, or concerted attack by the colony.

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EXPLANATION OF PLATE 1.

1. Mouth-parts of female wasp, *sericophorus teliferopodus,* sp. nov.
2. Pharyngeal plate and rods showing the ducts of the pharyngeal glands.
3. One of the 24 organs on the anterior margin of the glossa.
4. One of the short broad setae of the glossa.
5. Portion of the web of chitinous rods on the pulvillus of the tarsus.
6. Lateral view of the genitalia of the male wasp, *S. viridis* subsp, *roddi*, Raym.
7. Clavate antenna of the female.
8. Fourth and fifth tarsi with large pulvillus—ventral view.
9. Portion of pulvillus showing its wavy structure.
10. Oblique view of tarsi and pulvillus with the small claws retracted.
11. One of the claws.
12. Spiculae on tibia of male, *S. viridis* subsp. *roddi.*
13. Abdomen of female wasp.
14. Rugose channel of metathorax of female *S. teliferopodus* (compare with No. 6 in the text-fig.).
15. The short curved sting of the female indicates close contact with the victim.
16. Nodose anterior margin of the female clypeus.
17. The strigilis does not differ in the sexes.
18. Labrum of male, *S. viridis* subsp. *roddi.*
19. Median and apical segments of male flagellum.
20. Mandible of female—that of the male is more acute.
21. Anterior wing of female.
22. Posterior wing.
23. A myrtaceous (*Eucalyptus?*) pollen-grain taken from aesophagus of female.
24. Second (morphological) abdominal sternum of female.
25. Oblique view of apical segment of male flagellum.
26. Tessellate and punctate sculpture of the mesothorax.
27. The long and short calcariae of the hind tibiae have a parallel in the bee *Goniocolletes.*

(All parts are more or less distorted by pressure of the cover-glass on the mounted preparations.)

EXPLANATION OF PLATE 2

1. Fly, *Musca vetusstissima* Walk., prey of the wasp *S. sydneyi,* sp. nov.
2. Wing of the eastern fly, *Anastellorhina* (*Neopollenia*) *stygia* Fabr.
3. Wing of prey of smaller wasp. (Both wings drawn at same magnification.)
4. Arista of the western fly is plumose on the apical half; that of the eastern fly plumose for its entire length.
5. The slender leg of the fly is defenceless against the strongly-spined leg of the wasp.
6. The parasitized cell of the wasp is filled with the disjecta membra of flies.
7. Female *S. sydneyi* carrying the fly under her abdomen.
8. Larva of wasp in its cocoon (anterio—dorsal view).
9. Sandy cocoon of the larva.
10. Portion of cocoon viewed by transmitted light to show grains of sand.
11. Silken threads are woven in a close spiral on the inner surface.
12. Lateral view of scutellum of *S. sydneyi* showing the large tubercle.
13. The spinose pygidial plate of the wasps, when bent forward under the abdomen, assists in holding the prey.
14. The granular sculpture of the mesothorax of *S. sydneyi* (compare fig. 26, pl. 1).
15. The hamuli of the wasps lack the strength of those of bees.
16. Mesh of silk threads in cocoon more highly magnified.

17. The coarse spines and antenna-cleaner of the anterior basitarsus of the wasp.
18. Structure of the prosternal furcae of the wasp.
19. Costal margin of wing of fly.
20. The appearance of the glossa of the fly, at low magnification, is not altogether unlike the web of the wasp's pulvillus.
21. Costal edge of wing of the wasp.

EXPLANATION OF PLATE 3

1. Adult female *Sericophorus nigror* Raym. with the highly flexible abdomen thrust forward to attack with the sting.
2. Anterior view of head-capsule of female.
3. Posterior view of head-capsule of *S. sydneyi* Raym.
4. Egg of *S. sydneyi;* larva within almost ready to hatch out.
5. Ventral surface of male fly, *Musca vetusstissima,* with egg of the wasp adhering to episternum.
6. Tarsal rake or comb of female *S. nigror.*
7. Tarsal rake of female *S. teliferopodus* Raym.
8. Pygidial plate of *S. victoriensis* Raym.
9. Pygidial plate of *S. nigror* Raym.
10–11. Two oblique views of the modified apical segment of flagellum of female *S. sydneyi* Raym.
12. Seventh sternum of male *S. violaceus* Raym.
13. Sixth sternum of male.
14. Tarsal rake of male.
15. Fifth sternum of male; note irregular line of the gradulus.
16. Lateral view of genitalia of male *S. violaceus.*
17. Posterior dorsal view of genitalia.
18. Seventh abdominal tergum with pygidial plate.
19. Wing of mutation showing the duplication of the second recurrent nervure.
20. Mite *Tyrophagus putrescentiae* Schk. taken with pollen from mandibles of *S. teliferopodus okiellus* Raym.
21. The dentate margin of the penis-valve of *S. violaceus* Raym. X. 600. (Compare with fig. 6, pl. 1).

EXPLANATION OF PLATE 4

Epinotum of species in the genus *Sericophorus;* the small circle shows the sculpture of the dorsum. All are presented in oblique dorsal views to show the declivity.

1. *S. bicolor Sm.* The sculpture of the small dorsum is masked by circular tufts of hair.
2. *S. nigror* Raym. The declivity of the long epinotum is masked by pale hair, but the dorsum is finely rugose.
3. *S. spryi* Raym. is close to *S. violaceus,* but is much smaller.
4. *S. rufipes* Raym. The declivity has a number of small transverse carinae below the incisure.
5. *S. claviger* Kohl. has deep pits laterally, but is small.
6. *S. relucens* Sm. has the scutellum and postscutellum red.
7. *S. teliferopodus* Raym. is the largest species.
8. *S. chalybaeus* Sm. The lateral margin is deeply pitted, and the rugae tend to extend over the declivity and dorsum.
9. *S. pescotti* Raym. has the scutellum and postscutellum black.
10. *S. victoriensis* Raym. and *S. subviridis* Raym. have a similar sculpture on the epinotum.

11. *S. violaceus* Raym. has only a few large pits laterally.
12. *S. gracilis* Raym. has a peculiar short incisure.
13. *S. viridis* Sauss. is near to *S. teliferopodus* Raym.
14. *S. sydneyi* Raym. has very fine carinae laterally.

Comparative sizes are indicated by the amount inclosed in the field of a 1-in. objective. In *pescotti* the entire thorax is included; only the margin of the scutellum appears in *viridis*, but almost the full length of it in *violaceus*.

EXPLANATION OF PLATE 5

Structure of propodium of species in the genus *Sericophorus*. The small circle shows the sculpture of the dorsum.

1. *S. brisbanensis* Raym. is small, but has large "honey-comb" rugae.
2. *S. castaneus* Raym. has larger pittings.
3. *S. cyanophilus* Raym. has only a few coarse rugae laterally.
4. *S. elegantior* Raym. is slender with a few coarse rugae.
5. *S. hackeri* Raym. approaches *S. brisbanensis*.
6. *S. inornatus* Raym. has fine inconspicuous rugae; the cruciform incisure is hardly defined. *Left*—the compressed tubercle of the scutellum is similar to that of *S. subviridis* Raym.
7. *S. lilacinus* Raym. has numerous fine rugae.
8. *S. metallescens* Raym. is close to *S. rugosus*, but is much smaller, and the incisure hardly defined.
9. *S. subviridis* Raym. has many fine rugae.
10. *S. rufobasalis* Raym. has few rugae, but much white hair.
11. *S. rugosus* Raym. has coarse rugae over the entire surface, and the bar of the incisure is hardly defined. (Compare with No. 8.)

EXPLANATION OF PLATE 6

1. The dorsal tubercles and eight lateral "buds" of the larva were unchanged for 154 days. (See text-fig. 3, No. 3, for early larval stage on 1st May.)
2. Oblique dorsal view of larva on 20th October; it measured only 5.5 mm. in length.
3. On 15th September, the dorsal surface was contracted, and the ventral surface expanded.
4. At a later stage, 28th November, the ventral surface was contracted, and the dorsal surface greatly expanded.
5. The translucent apical segment is frequently retracted and extruded just before the pupal change about 3rd January.
6. The dorsal nodes had developed to bi-tuberculate ridges by the above date.
7. Outline of an incipient abdominal segment showing the lateral "buds" being absorbed 10th December. The adult stage was reached about the 1st February.
8. Genitalia of *S. chalybaeus* Sm. 8A. Serrated process more highly magnified.
9–9A. Apical plates of abdomen of male *S. chalybaeus* Sm.
10. Pore-organs at articulation of trochanter *S. relucens* Sm. X. 600.
11. Oblique view of genital capsule of male blow-fly, *Neopollenia stygia* Fabr.
12. Portion of gland from male fly—5 cm. approximately in length; the entire alimentary canal was only 25 mm. in length.
13. Several of the lobules more highly magnified.
14. Three of the lobules magnified X. 600.
15. Clypeal teeth of male *S. chalybaeus* Sm.

By the serrated process of the genitalia and the apical sternum of *S. chalybaeus* Sm., the species is related to *S. violaceus* Raym. and *S. rufotibialis* Raym.

EXPLANATION OF PLATE 7

1. Adult male *Astaurus hylaeoides*, gen. et. sp. nov.
2. Front view of the head capsule.
3. Sculpture of the dorsum of the epinotum, oblique view.
4. Genitalia.
5. Hind tibia, with spiculae and calcariae.
6. Seventh abdominal sternum.
7. Ninth abdominal sternum.
8. Seventh tergum with pygidial plate.
9. Tarsi of anterior leg.
10. The strigilis of anterior leg has a short broad malus, and a mere line of hyaline velum.
11. At the base of the scapes is a pair of sharp teeth.
12. The nine hamuli are strongly developed.
13. The mandible of the male has a yellow spot near the base.
14. The close coarse punctures of the abdominal sterna.
15. One of the simple hairs.
16. The claws of the tarsi are simple.
17. Scattered piliferous punctures of the mesothoracic disc.
18. Lateral view of the epinotum of male.

EXPLANATION OF PLATE 8

1. Fourth abdominal sternum of *Sericophorus tallongensis* Raym. Note the small curved gradulus.
2. Fifth sternum of *S. cliffordi* Raym. lacks the gradulus.
3. Fifth sternum of *S. tallongensis* Raym.
4. Seventh sternum of *S. cliffordi* Raym.
5. Seventh sternum of *S. tallongensis* Raym.
6. Antennae of male *S. cliffordi* Raym. Note the twelve segments similar to those of the female.
7. Portion of a segment of the male flagellum more highly magnified to show three kinds of organs. A. View of C. from above. B. One of the small dark hairs. C. Lateral view of one of the largest organs X. 700.
8. Genitalia of *S. cliffordi* Raym. are distinct by the large serrated processes of the claspers.
9. One of the serrated margins more highly magnified to show—D. Large teeth, and E. small teeth.
10. Genitalia of *S. tallongensis* Raym. are remarkable for the large ventral processes and the minute serrations of the claspers.
11. One of the "claspers" more highly magnified.
12. Some of the "teeth" of the serrated margin X. 700.
13. The teeth of the claspers in genitalia of *S. violaceous* Raym. are very regular.
14. Sixth sternum of *S. cliffordi* Raym.
15. Portion of galea showing the inner comb and dark bands of *S. teliferopodus* Raym.
16. Anterior view of emarginate glossa of female.
17. A few of the pollen-grains removed from *S. rufitibialis* Raym. were not of the Myrtle family, and may have been accidental contamination.
18. Anterior margin of clypeus of female *S. cliffordi* Raym. has three nodules, counting that of the angle.
19. Anterior margin of the male clypeus lacks teeth.
20. One of the ovarian tubules of female *S. teliferopodus* Raym. showing eggs at various stages of development.
21. Three views of the modified apical segments of flagellum of male *S. tallongensis* Raym. The flagellum of male *S. cliffordi* is not modified.

EXPLANATION OF PLATE 9

1. Dorsum and lateral carinae of epinotum of female *S. occidentalis* Raym. (The small circles represent the sculpture of the dorsum.)
2. Epinotum of male *S. cliffordi* Raym.
3. Epinotum of female *S. relucens nigricornis* Raym.
4. Epinotum of female, *S. froggatti* Raym.
5. Epinotum of male, *S. tallongensis* Raym.
6. Dorsal view of genitalia of male, *S. rufobasalis* Raym.
7. Lateral view.
8. Serrations more highly magnified to show wide and narrow spacing of the teeth.
9. Anterior wing of female with only two cubital cells.
10. Mesophragma of male; oblique lateral view.
11. Posterior view.
12. Clypeal teeth of female *S. occidentalis* Raym.
13. Clypeal angles of male *S. tallongensis* Raym. (Absence of nodular teeth is an excellent sex-character of males in this genus.)
14. Clypeal teeth of female *S. cliffordi* Raym.
15. Clypeal teeth of female *S. relucens nigricornis* Raym.
16. Apical sternite of male *S. rufobasalis* Raym.
17. Clasper of genitalia more highly magnified.
18. Genitalia of *S. claviger* Kohl., oblique view.
19. Apical sternite of male.
20. Clasper of genitalia more highly magnified.
21. Serrated process more highly magnified.
22. Apical segments of flagellum of *S. rufobasalis* Raym.

EXPLANATION OF PLATE 10

1. Genital capsule of male wasp, *Sericophorus hackeri* Raym.
2. Eighth abdominal sternum.
3. Clasper (penis valve).
4. Serrated margin of clasper more highly magnified.
5. to 8. *S. spryi* Raym.
9. to 12. *S. rufotibialis* Raym.
13. to 16. *S. brisbanensis* Raym.
17. to 20. *S. minutus* Raym.
21. to 24. *S. claviger burnsiellus* Raym.
25. to 28. *S. metallescens* Raym.
29. Fourth abdominal sternum *S. spryi* Raym. Note the almost straight gradulus.
30. Seventh abdominal sternum *S. claviger burnsiellus* Raym.
31. Seventh abdominal sternum *S. rufotibialis* Raym.

(All homologous parts are shown in the same relative position, and drawn at the same magnification. There is some deformity due to pressure by the cover-glass.)

EXPLANATION OF PLATE 11

No. 1 indicates the site of the original colony of 50 shafts observed in 1949. The wasps continued their occupation during 1950–51.

No. 2 colony, across the road, was founded in 1950, and worked in 1951.

Nos. 3 and 4 were founded in 1951, and all were derived from the parent colony. It will be seen that the four colonies are established on the eastern and the northern sides of a "square" of houses, and so receive the full warmth of the sun, and also the hot wind of summer. They are, however, well sheltered

from the cold winds, not only by the houses, but also by a row of trees, *Eucalyptus botryoides,* perhaps 30 feet tall, along the western border. All of the other trees surrounding the rectangle are *E. ficifolia, E. calophylla,* and *E. leucoxylon,* some 5 feet tall. There are thickets of tea-tree, *Leptospermum laevigatum,* say, 5 to 15 feet tall, growing in the angles of the large " corners " of the area. There is, therefore, an abundance of nectar and pollen for the wasps.

The position of the colonies, indicated by black dots, shows that the wasps crossed the bitumen road on two occasions, to dig in the soft sand of the " nature-strips " bordering the roadway.

Experiments in breeding these wasps should no doubt be conducted in " sanctuaries " having a similar aspect, since it is preferred by the insects.

EXPLANATION OF TEXT-FIGURE 1

Pollen-grains removed from the mouth-parts of sericophorine wasps.

1. *Godetia* sp.? (garden)	*S. spryi* Raym.	Mordialloc, V.
2. *Tristania conferta*	*S. gracilis* Raym.	Glen Aplin, Q.
3. Leguminous sp.	*S. teliferopodus* Raym.	Carrum, V.
4. *Eucalyptus* sp.	*S. gracilis* Raym.	Glen Aplin, Q.
4. *Melaleuca ericifolia*	*S. chalybaeus* Sm.	Wannon, V.
6. *Melaleuca* sp.	*S. viridis* subsp. *roddi*	Lane Cove, N.S.W.
7. *Leptospermum* sp.	*S. teliferopodus* Raym.	Noble Park, V.
	S. viridis Sauss.	Mt. Victoria, N.S.W.
8. *Kunzia ambigua*	*S. claviger* Kohl.	Woollahra, N.S.W.
9. *Isopogon* sp. or *Goodenia* sp?	*S. viridis* subsp. *roddi*	Sydney, N.S.W.
10. *Melaleuca* sp.	*S. viridis* subsp. *roddi*	Sydney, N.S.W.
11. *Leucopogon* sp?	*S. teliferopodus* Raym.	Cheltenham, V.
12. Myrtaceous sp.	*S. viridis* Sauss.	Wynyard, Q.?
13. Myrtaceous sp.	*S. lilacinus* Raym.	Wynyard, Q.?
14. Bot. sp. unknown Composite?	*S. teliferopodus* Raym.	Beaconsfield, V.
15. *Pimelia* sp?	*S. teliferopodus* Raym.	Beaconsfield, V.
16. Leguminous sp?	*S. lilacinus* Raym.	Wynyard, Q.?
a. Hakea sp.?	*S. lilacinus* Raym.	Wynyard, Q.?

EXPLANATION OF TEXT-FIGURE 2

1. Lateral view of thorax of *Sericophorus violaceus* Raym.
2. Wing of mutation of *S. spryi* Raym. with only two cubital cells.
3. Apical segment of flagellum of *S. claviger burnsiellus* Raym.
4. Mandible of *S. rufobsalis* Raym.
5. Clypeal margin of *S. rugosus* Raym. has only the tooth of the produced angle. This form is similar to that of *S. hackeri* Raym.
6. The angle is sharper in *S. claviger* Kohl. and the tooth is practically obsolescent in *S. rufobasalis.*
7. Clypeal margin of the northern race of *S. relucens* Sm. has three teeth.
8. *S. pescotti* Raym. is emarginate with only two teeth.
9. *S. patongensis* Raym. has three subequal teeth.
10. *S. elegantior* Raym. has three small teeth.
11. The nodular teeth of *S. metallescens* Raym. are conjoined.

12. The nodules of *S. cyanophilus* Raym.
13. Apical segment of flagellum of *S. relucens* Sm. (topotype).
14. The tarsal comb of *S. cyanophilus* Raym. has seven long spines.

EXPLANATION OF TEXT-FIGURE 3

1. Tumulus of sand excavated by female *Sericophorus teliferopodus* Raym.
2. Base of shaft with its two galleries; the cell contains a cocoon.
3. Larva with remnants of its meal on the ventral surface.
4. Mandible of the larva.
5. The numerous pale oenocytes are conspicuous in the dark body.
6. The rugose structure of the female *S. patongensis* Raym. (Compare with No. 11, pl. 5.)
7. Apical segment of the male flagellum.
8. The parasitic bombyliid fly in the genus *Systoechus*.
9. Antenna of the fly.
10. Haltere of the fly.
11. The larvae of the wasp may have many stiff black hairs.
12. The fly has a number of black and white scale-like hairs arranged in bands.
13. The parasitic mutillid wasp in the genus *Euphutomorpha* is brightly coloured.
14. Rain often cements a ring of sand on top of the tumulus.
15. There are three nodules laterally on the clypeus of *S. chalybaeus*, Sm. (Compare with No. 16 in pl. 1.)

EXPLANATION OF TEXT-FIGURE 4

Homologous structures in Bees and Wasps.

1. Five tarsal segments of a bee *Paracolletes paradoxus* Raym. (in M.S.).
2. Outer surface of five tarsal segments of a wasp, *Bembex tor* (in M.S.).
3. Inner surface. Males of *Megachile* often have black lines and dots.
4. Five tarsal segments of a bee, *Megachile lineatipes* Ckll.

"B." indicates the tarsal brush, and the arrow the comb of the antenna-cleaner.

EXPLANATION OF TEXT-FIGURE 5

1. Metathorax of *Anacrucis laevigata* Raym. (the small circle illustrates the sculpture of the dorsum).
2. Metathorax of *A. striatula* Raym.
3. Anterior wing of female.
4. Subfiliform antenna of *A. laevigata*.
5. Clypeus and nodular teeth of *A. striatula*.
6. Vertex of head-capsule of female.
7. Attachments of indirect vertical wing muscle to the chitin of the scutum.
8. Bituberculate swelling on frons of *A. laevigata*.
9. Anterior margin of clypeus of female.

EXPLANATION OF TEXT-FIGURE 6

1. Metathorax of *Anacrucis punctuosa*, sp. nov.
2. Metathorax of *A. asperithorax*, sp. nov.
3. Metathorax of *A. clypeata*, sp. nov.
4. Emarginate clypeus of *A. clypeata* and the teeth resemble those of *Megachile*.
5. Compressed apical segment of flagellum of *Sericophorus relucens nigricornis*.
6. Remarkable toothed median segments of antenna of a mutation.
7. Wing of a fly, prey of *Anacrucis punctuosa*.
8. Arista of fly.
9. Haltere of fly.

EXPLANATION OF TEXT-FIGURE 7

Graph showing minimum and maximum periods of excavation by a large " Colony " of wasps, *Sericophorus teliferopodus* Raym.

The data for the graph was obtained during the two active seasons of 1950, 1951, 1952, which were very remarkable years, for heavy precipitation in 1950 frequently washed away all traces of the yellow tumuli, creating insuperable difficulties in the daily enumeration of the shafts.

The summer of 1951 was marked by the highest temperatures ever recorded for the State; almost every week a wave of heat, often registering well over 100° F., was terminated by violent storms. The torrential rains brought all excavation to a halt, consequently, on a fine morning, large numbers of tumuli would suddenly appear, hence the vertical rises from zero.

This may not be the normal order, but daily observation of shafts marked with metal rings, showed that it is very probably the normal cycle.

EXPLANATION OF TEXT-FIGURE 8

1. Oblique view of dorsum of epinotum of female *Anacrucis ferruginea,* Raym.
2. Anterior margin of clypeus with two nodular teeth.
3. Tarsal comb of anterior legs.
4. Strigilis of anterior leg.
5. Conical apical segment of female flagellum.
6. Oblique view of dorsum of epinotum of female *A. cingulata* Raym.
7. The fine spines of the pygidial area.
8. Tarsal comb of anterior legs.
9. Sting apparatus of female *A. asperithorax* Raym.
10. Sensory organs at tip of gonostylus.
11. One of the sensory organs at X. 700.
12. In the mandibular notch of a female *Anacrucis* was portion of a fly's leg.

EXPLANATION OF TEXT-FIGURE 9

ORIENTATION OF SANCTUARIES

A survey of several colonies of wasps demonstrated that, where the cold winds blew from the South and West, the insects selected an aspect sheltered on those sides, with the East and the North open, especially to the morning sun.

The trees for the wind-break, and also the lower shrubs, should be chosen from the list of plants visited by the wasps. It will be seen that the botanical family MYRTACEAE is most favoured, and local species should be planted.

Such " Sanctuaries " should have an area of approximately 1 acre, enclosed with a rabbit-proof fence, until the colony is established. The wasps will naturally extend to other suitable areas. The orientation figured here will conform with the conditions indicated in plate 11.

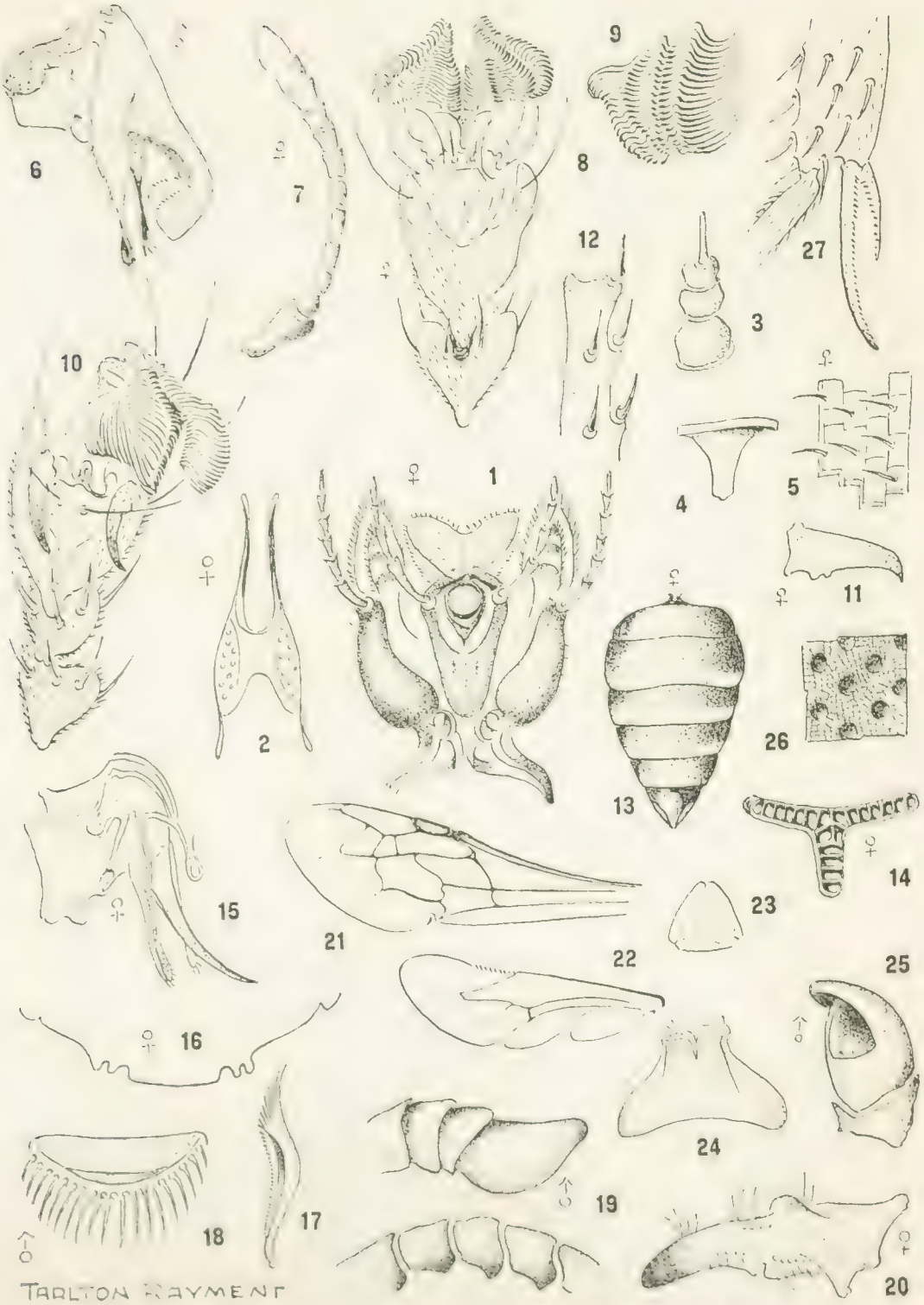


PLATE 1. Details of wasp *Sericophorus teliferopodus* Raym.

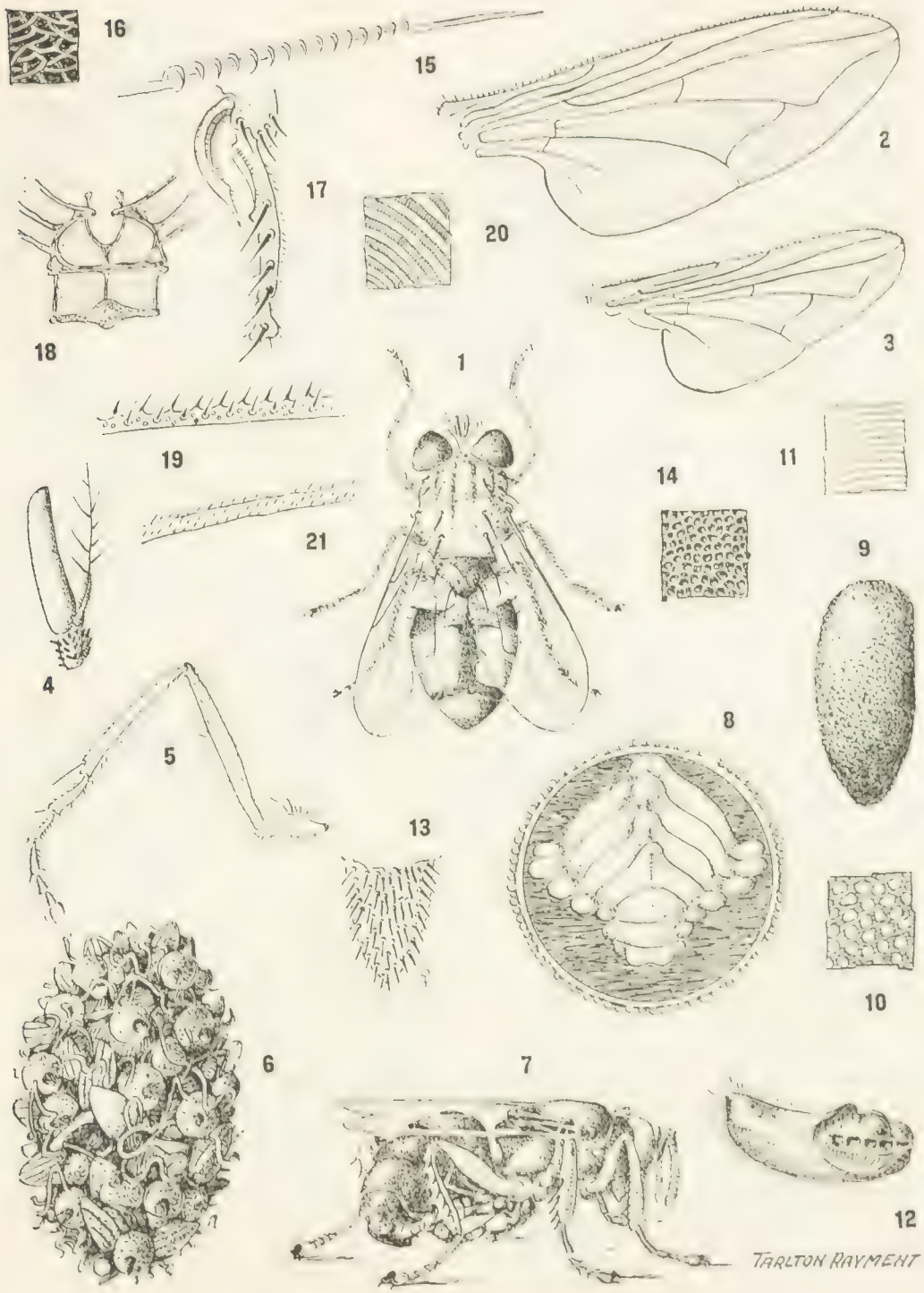


PLATE 2. Details of Wasp *Sericophorus sydneyi* Raym.

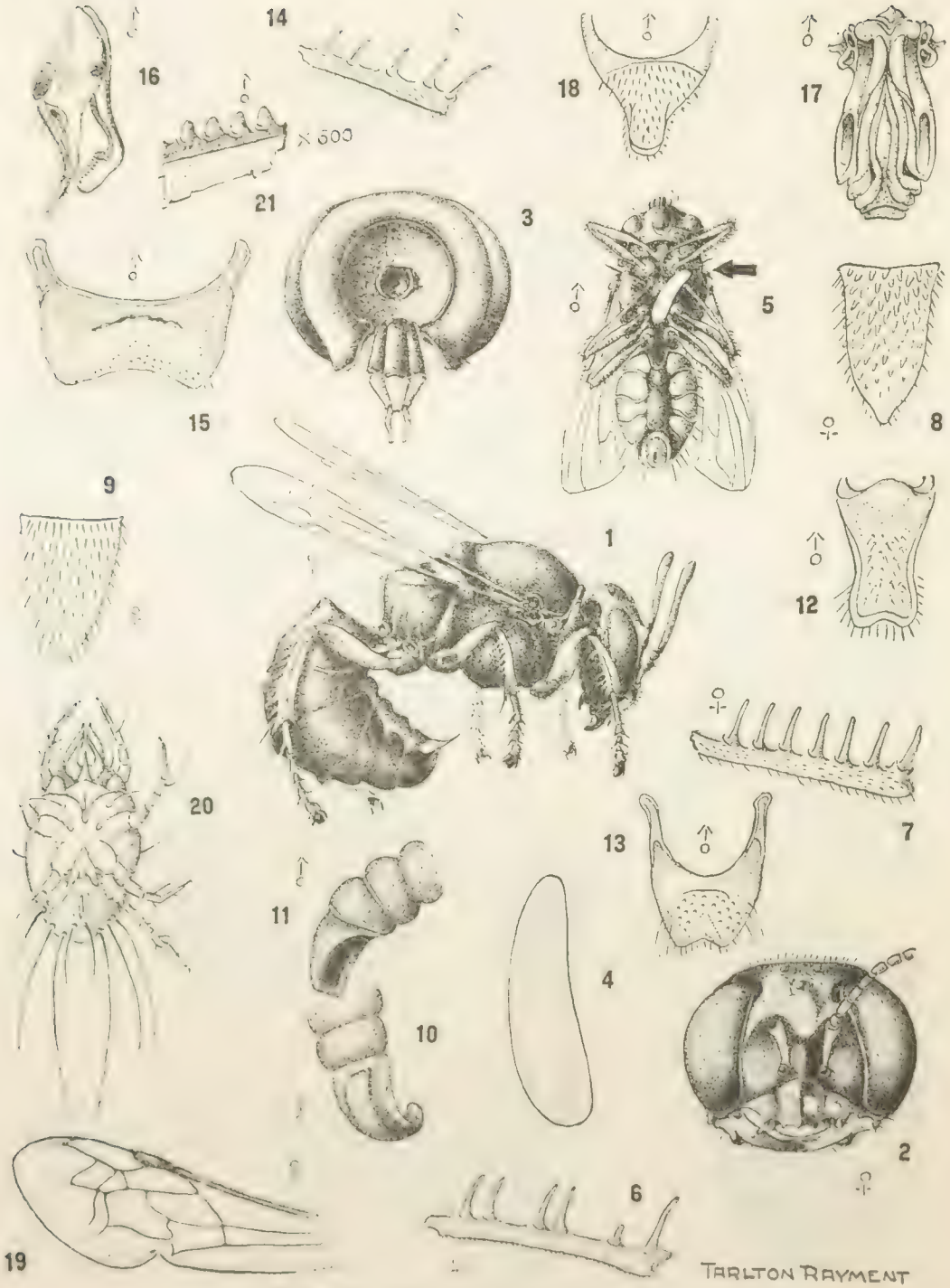


PLATE 3. Details of *Sericophorus*.

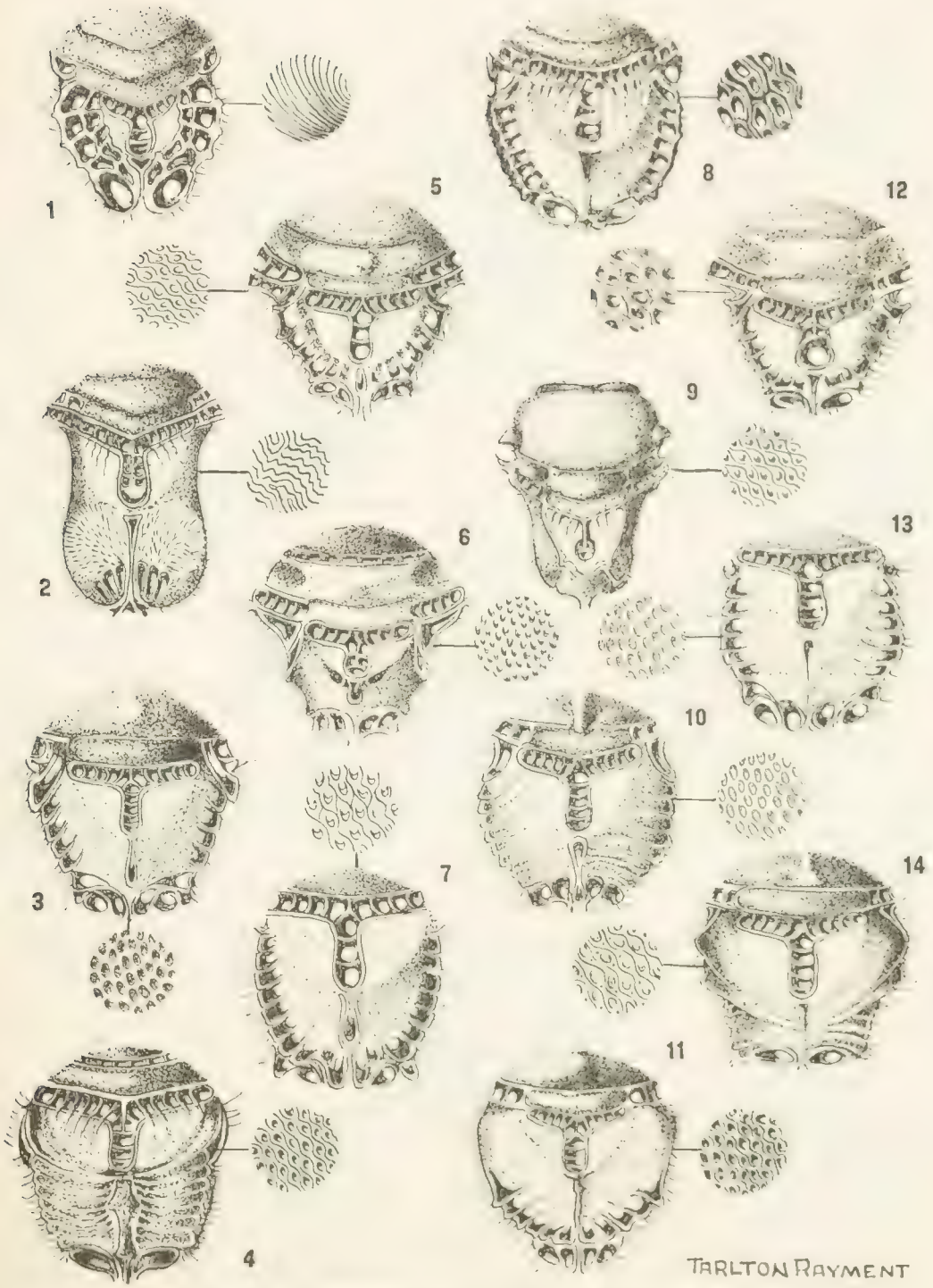


PLATE 4. *Sericophorus.* Views of Metathorax.

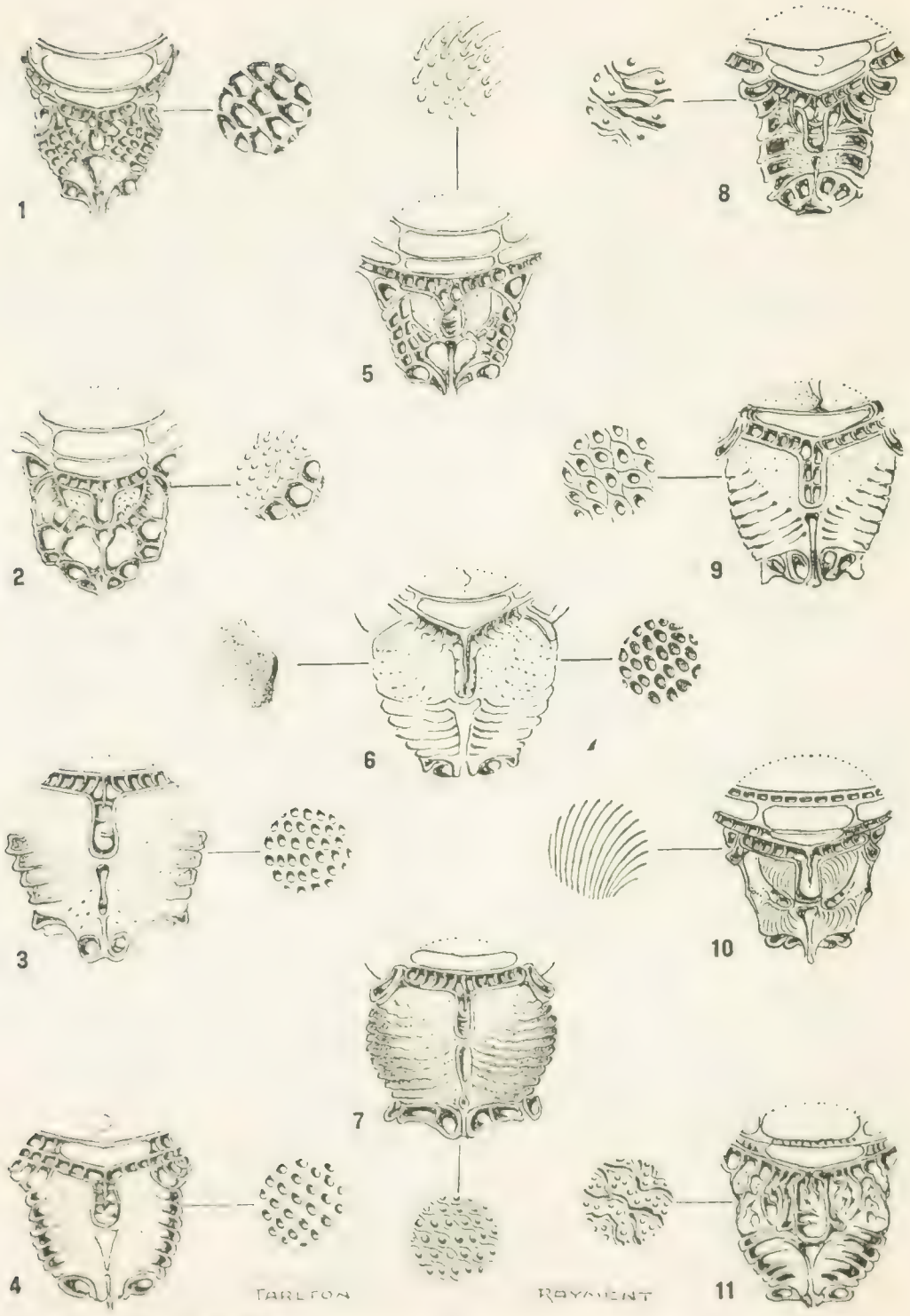


PLATE 5. *Sericophorus.* Views of Metathorax.

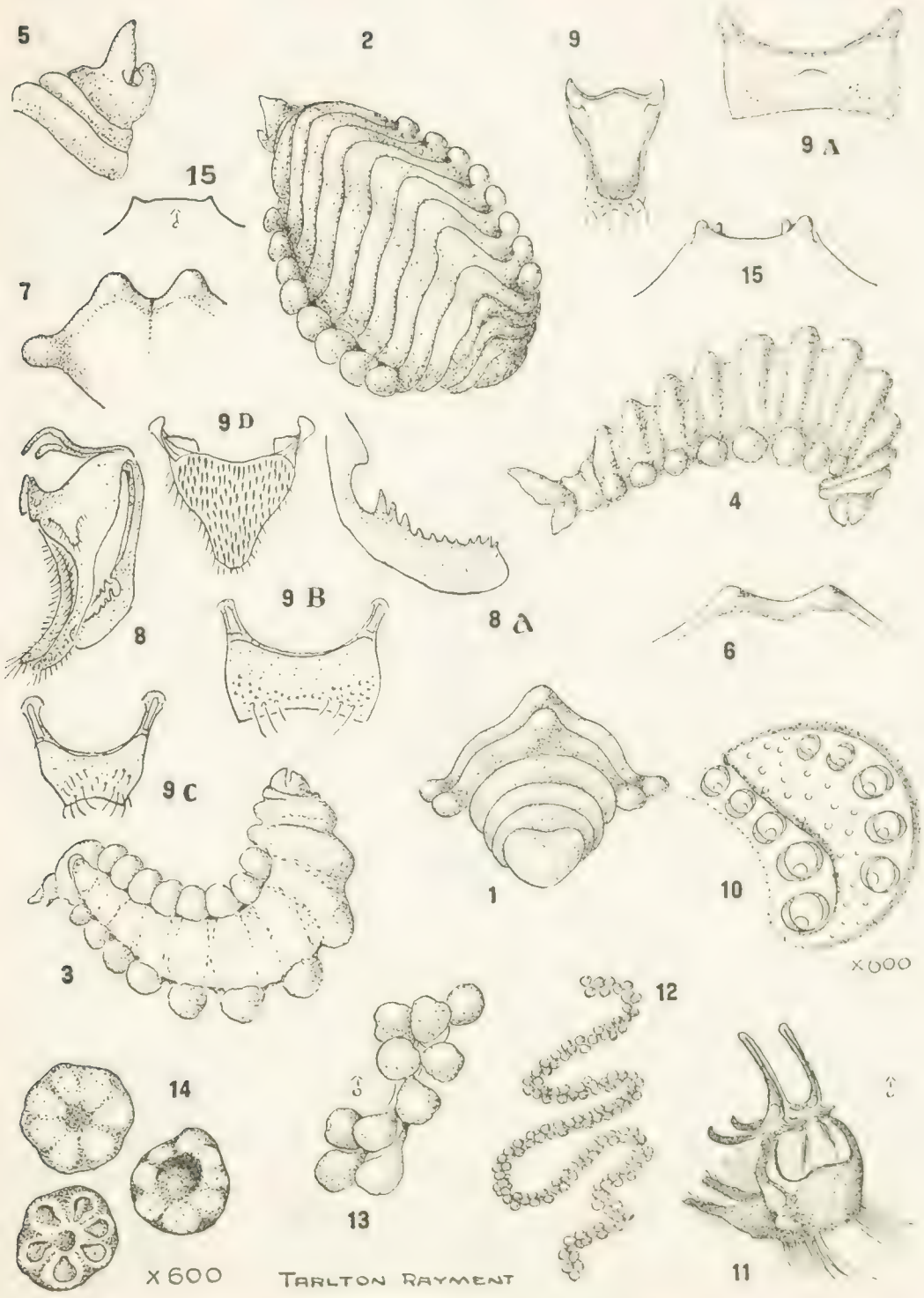


PLATE 6. *Sericophorus* larva and other details.

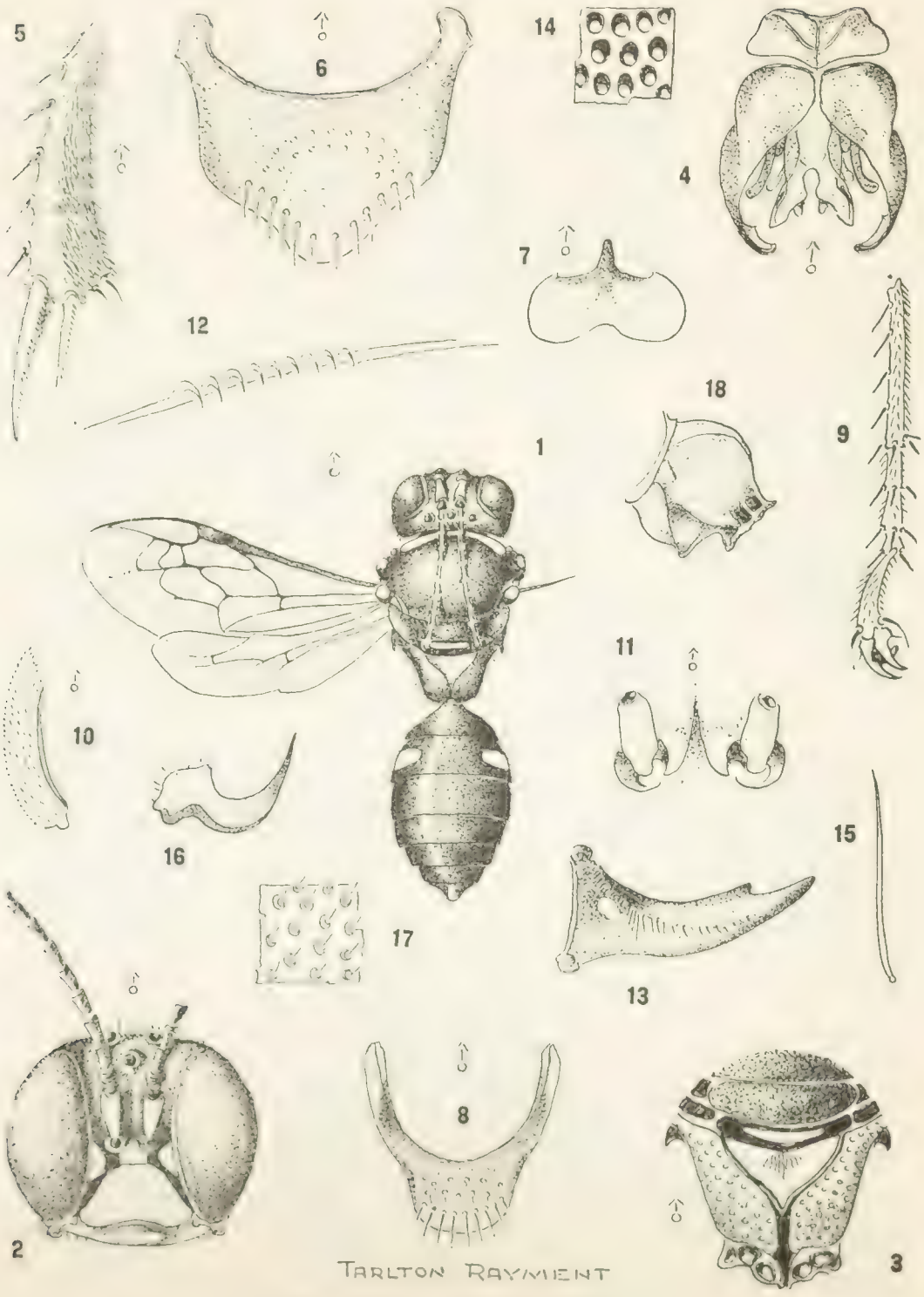


PLATE 7. Astaurus hylaeoides.

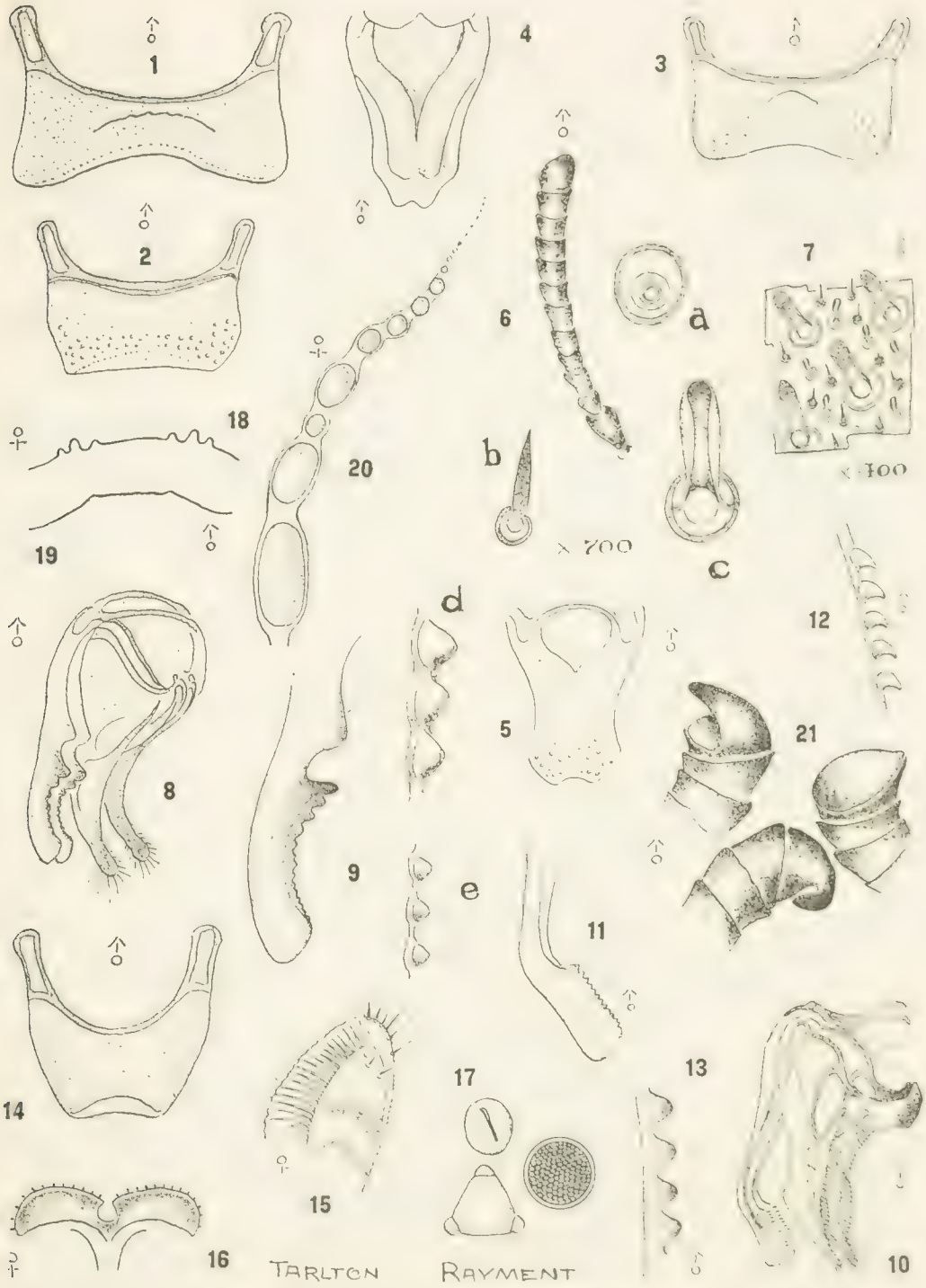


PLATE 8. Morphological details of male Wasps *S. tallingensis* and *S. cliffordi* Raym.

PLATE 9. *Sericophorus.*

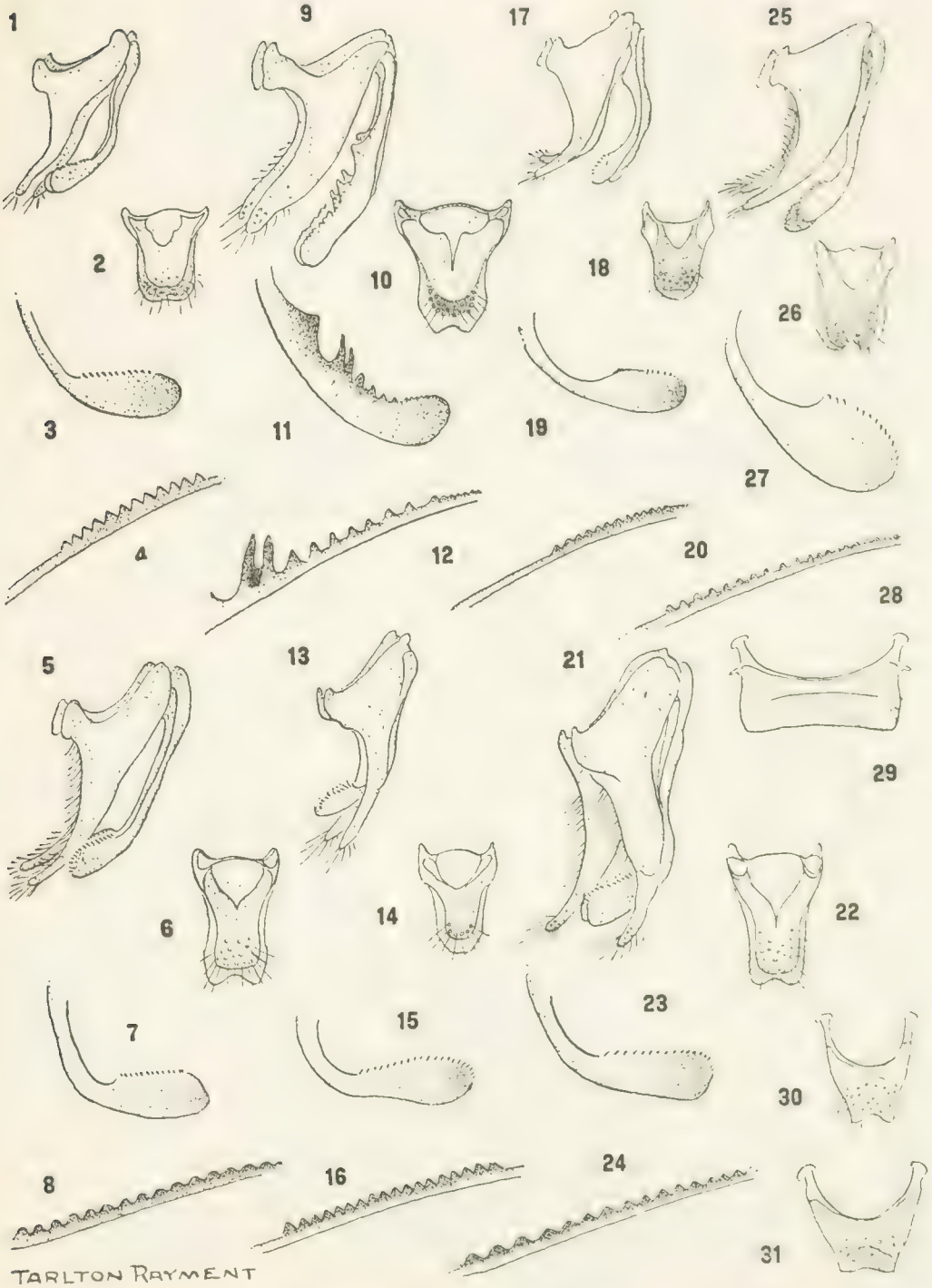


PLATE 10. Sericophorus males.

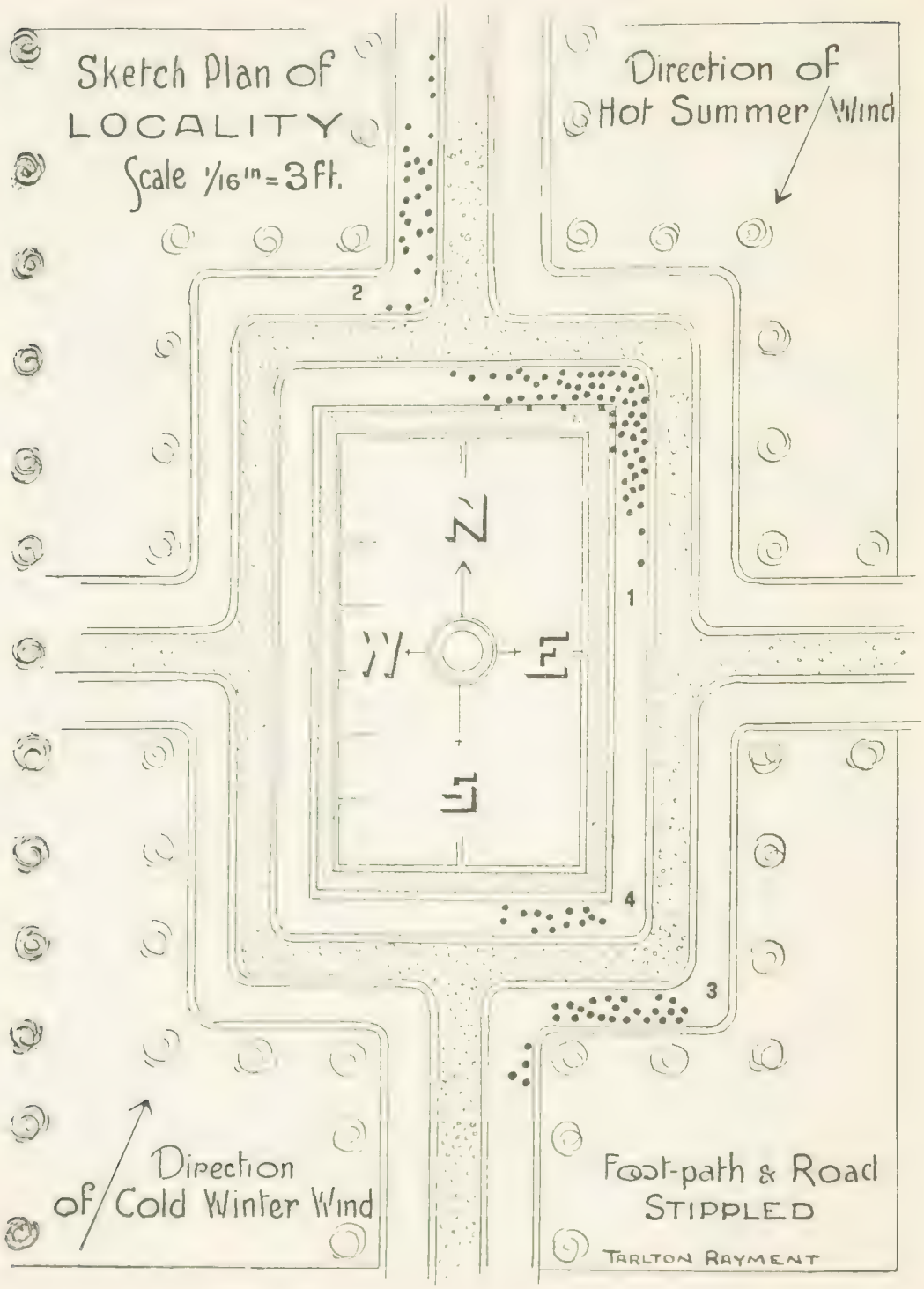
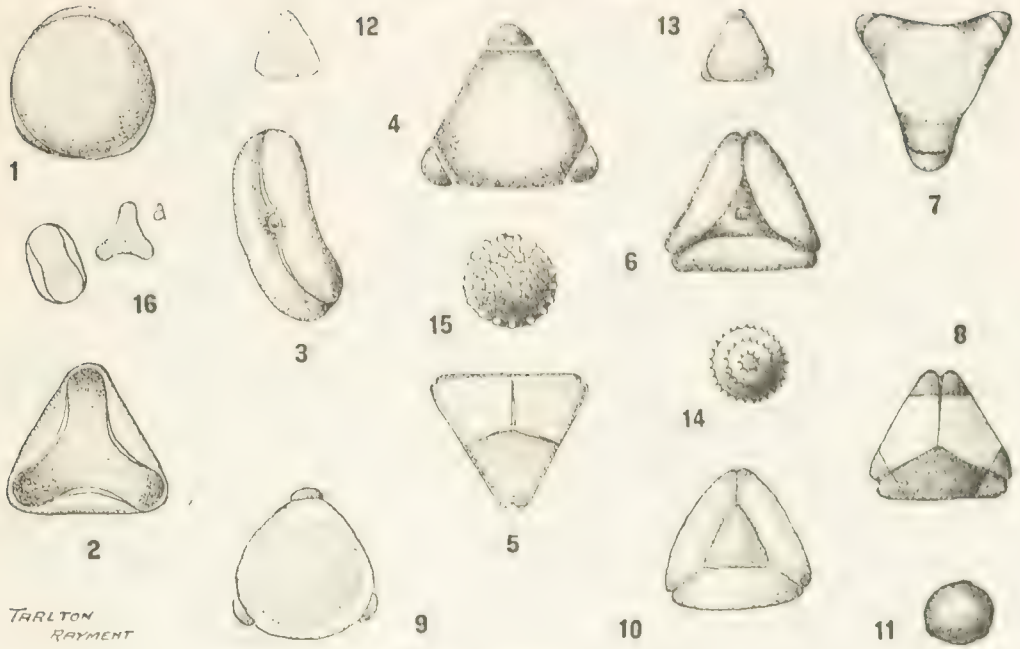
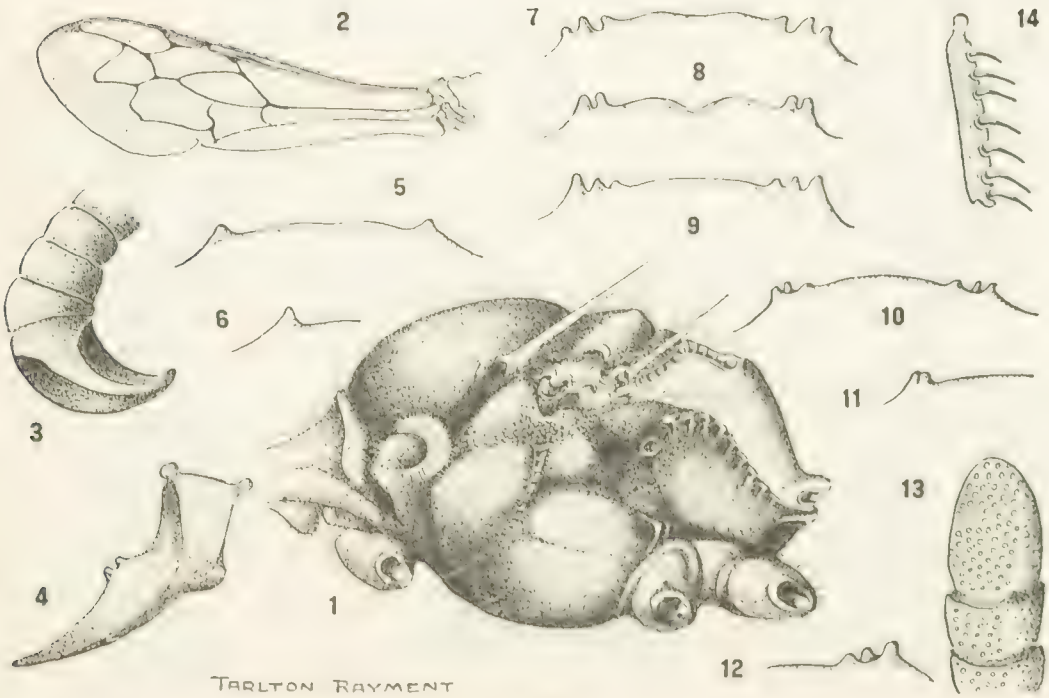


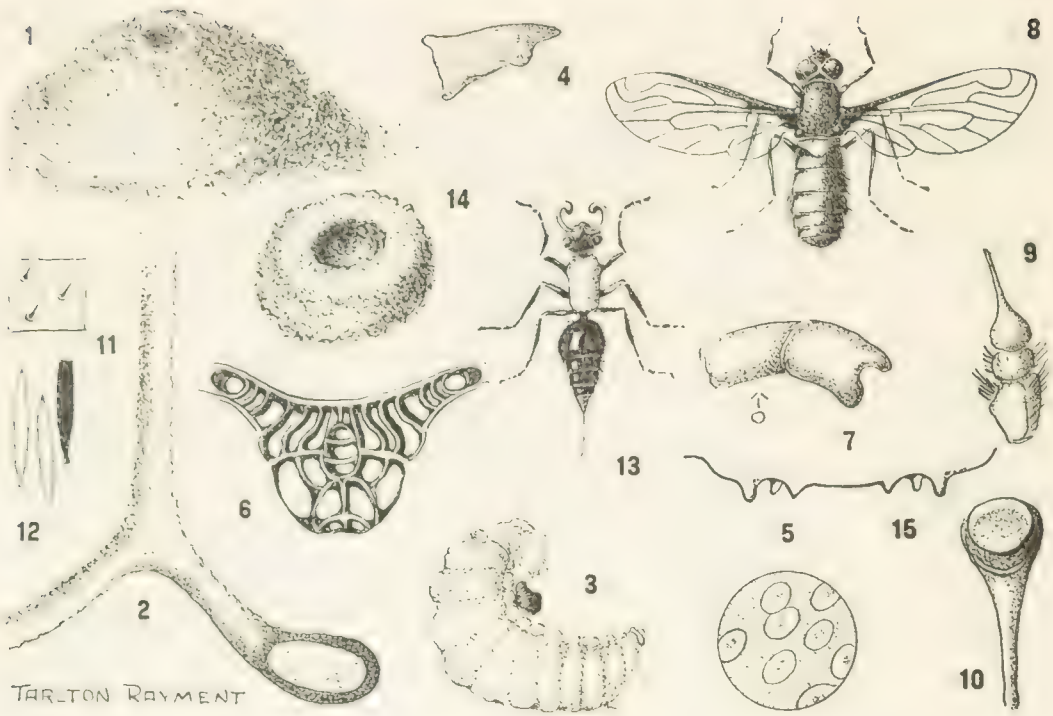
PLATE 11. Locality of nests of *Sericophorus*.



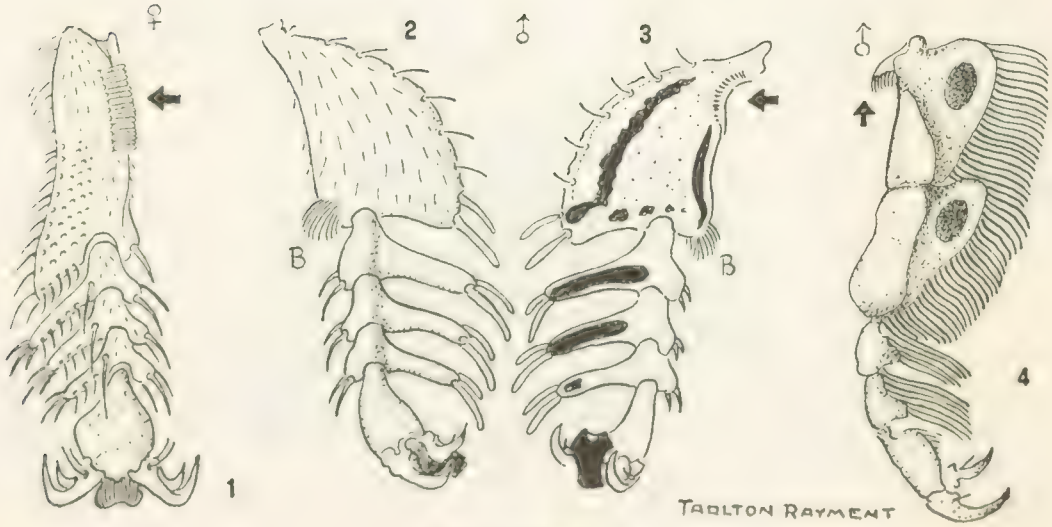
TEXT FIGURE 1.



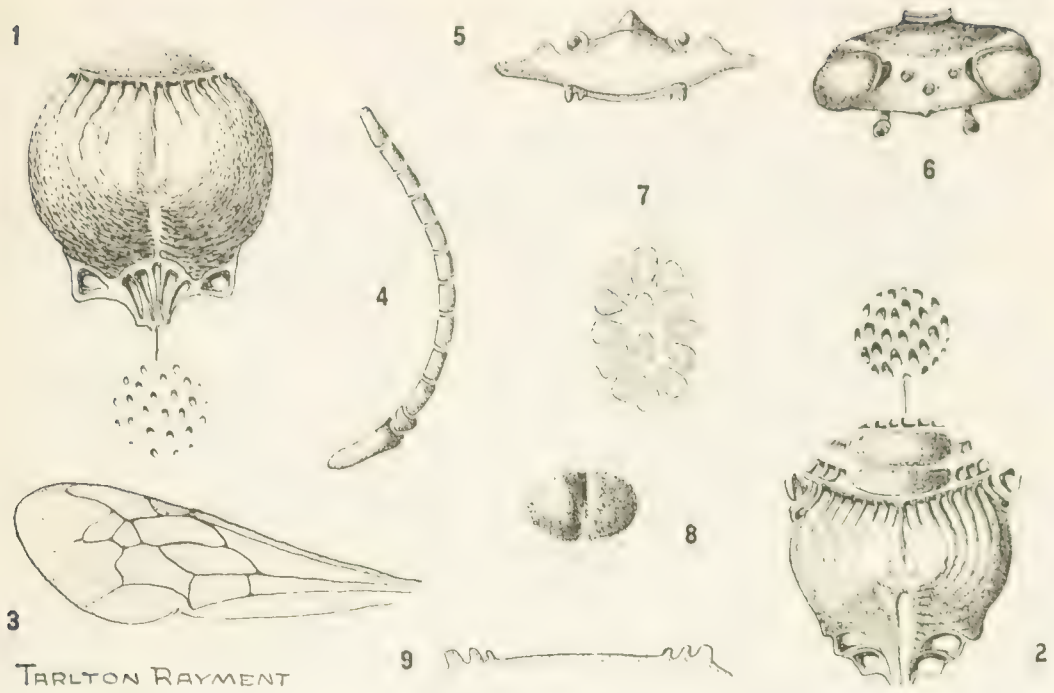
TEXT FIGURE 2.



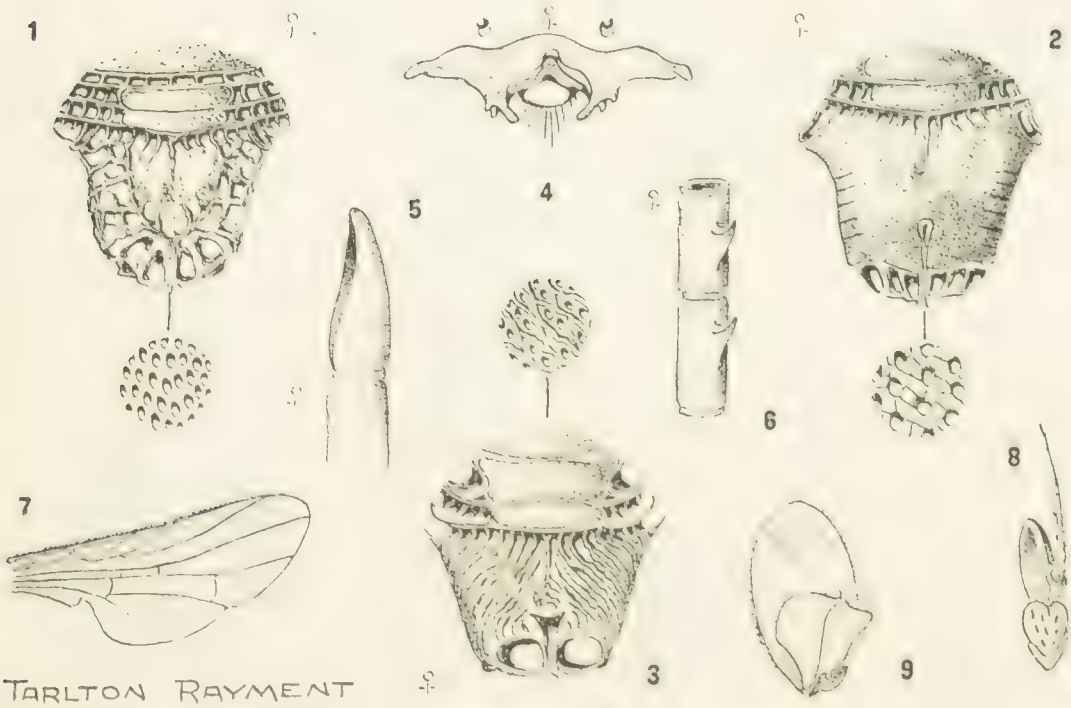
TEXT FIGURE 3.



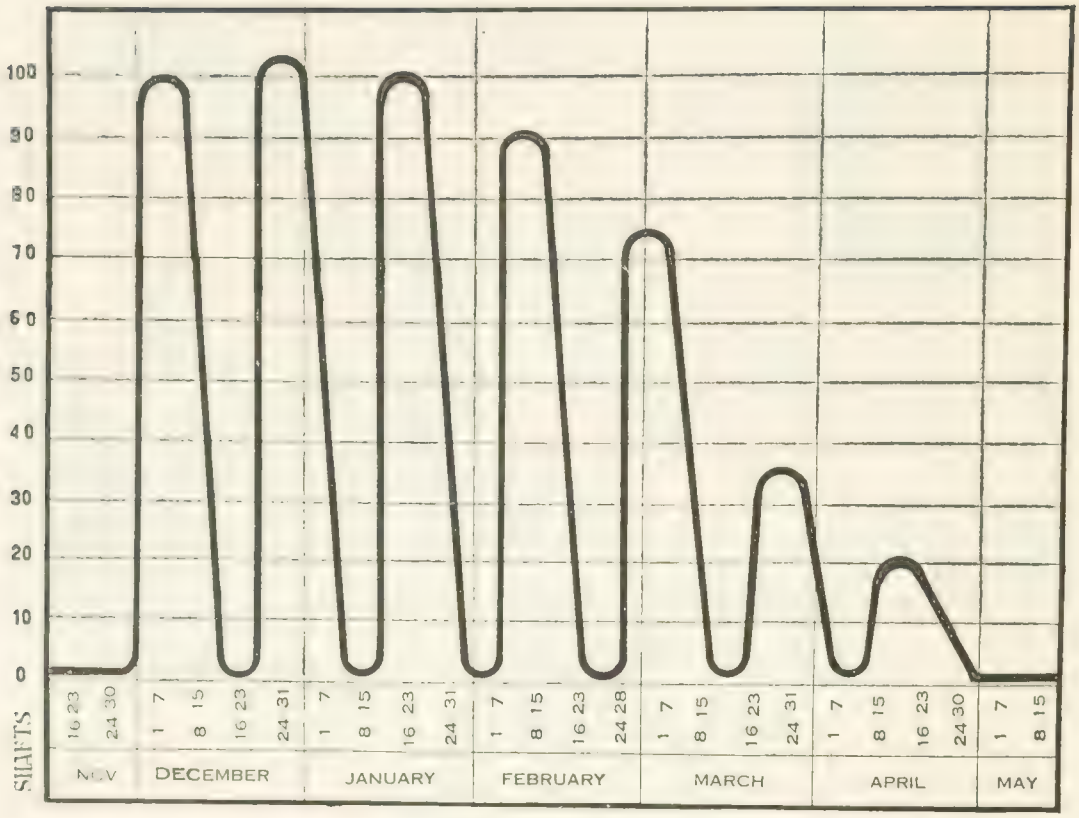
TEXT FIGURE 4.



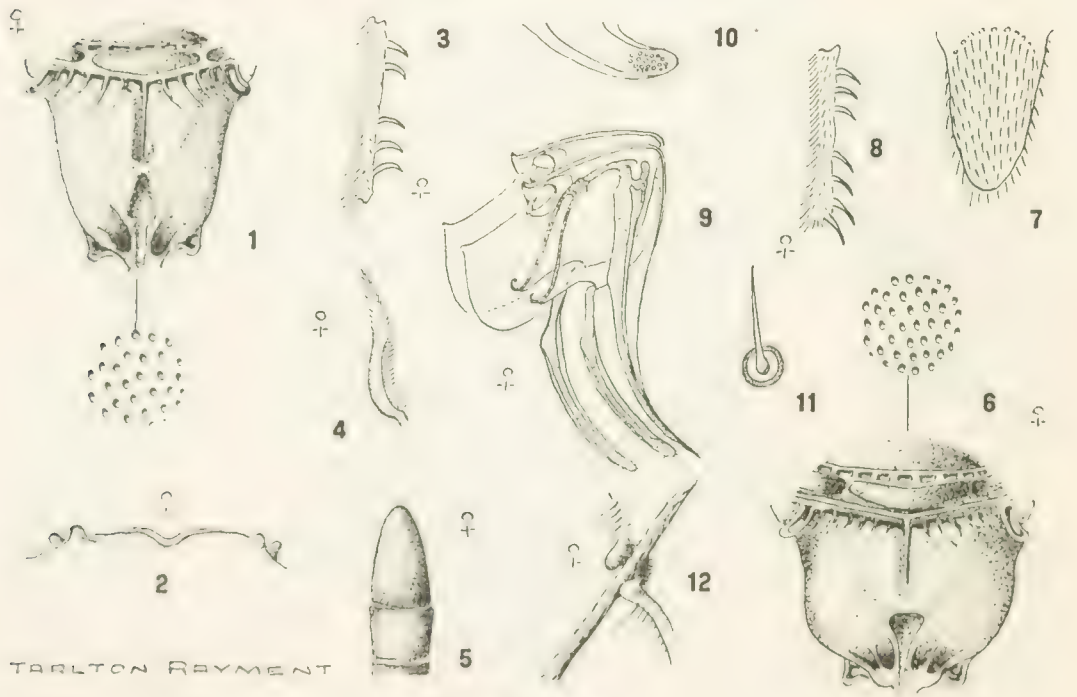
TEXT FIGURE 5.



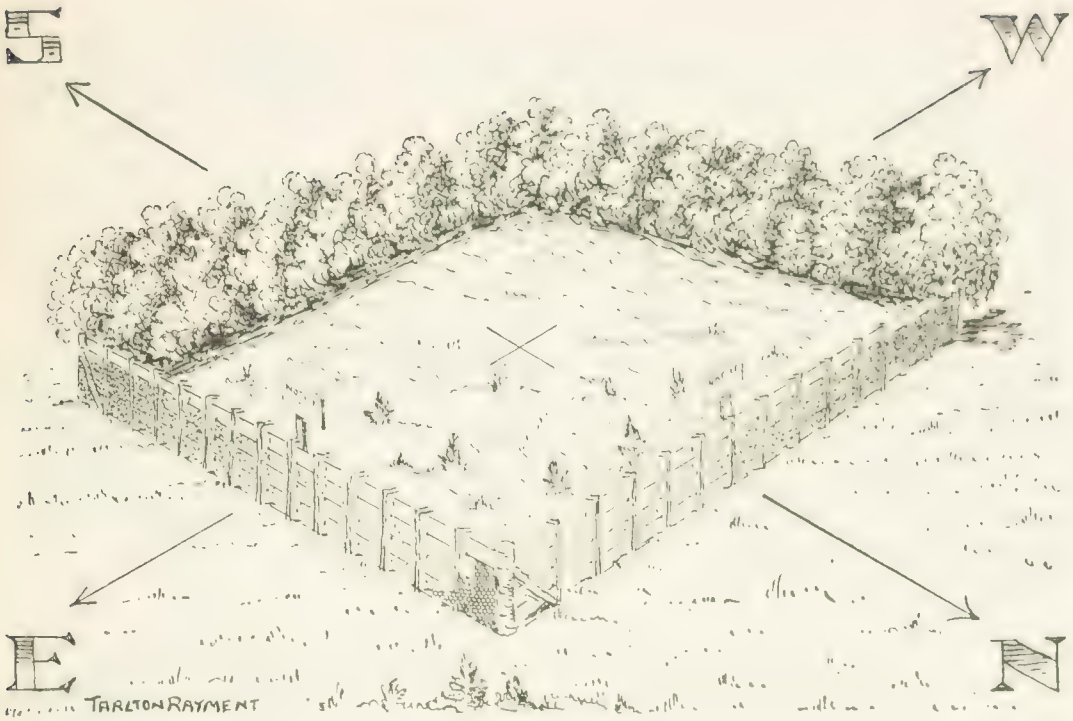
TEXT FIGURE 6.



TEXT FIGURE 7.



TEXT FIGURE 8.



TEXT FIGURE 9.

FLUORINE-PHOSPHATE RATIOS IN RELATION TO THE AGE OF THE KEILOR SKULL, A TERTIARY MARSUPIAL, AND OTHER FOSSILS FROM WESTERN VICTORIA

By Edmund D. Gill, B.A., B.D., F.G.S., Curator of Fossils, National Museum of Victoria.

Summary

Fluorine analyses indicate the relative ages of fossil bones from sites in Central and Western Victoria. They show that the Keilor Skull is a true fossil and not a recent burial; also that a fossil kangaroo jaw from near Hamilton does belong to the Lower Pliocene marine bed whence it was extracted. A Tertiary cuscus tooth from the same area is recorded. Causes of variation in fluorine index are discussed.

The Fluorine Index

Every ton of the earth's crust averages something like 300 grams of fluorine (Mason 1952), and for any given groundwater environment with fluorine in solution, the accumulation of fluorine ions by fossil bones, if pervious, is a function of time. Thus bone fossils of the same age and in the same geological formation will possess comparable amounts of fluorine, and be distinguishable from any bones in that formation introduced somewhat later by natural or human burial, insertion down joint planes, cracks, caverns, animal and bird burrows, and such like. Rock matrices of fossil bones vary both in permeability (contrast clays and gravels) and fluorine content, and so different geological formations may possess differing ground waters in respect both to circulation and fluorine content.

The hydroxylapatite of bone possesses a molecular structure with a high affinity for fluorine ions, and so if any of the latter are available, they are readily assimilated, thus forming the stable compound fluorapatite. Recognizing that varying amounts of secondary minerals in fossil bones could vitiate a figure giving simply the percentage by weight of fluorine, Oakley and Hoskins (1950) have related this figure to the percentage by weight of phosphorus (as $P_2 O_5$) with which the fluorine is chemically associated. The result is presented by a figure calculated thus:—

$$\frac{\% \text{ Fluorine} \times 100}{\% \ P_2 O_5}$$

It is suggested that this figure be known as the *Fluorine Index.*

After analyzing hundreds of fossil bones and experimenting with radioactive tracers, Cook (1951) came to the conclusion that "the diffusible anions, phosphate and carbonate, can enter or leave dead or fossil bone with very great facility. It is further probable that such movement is based upon an interchange of ions between the bone substance and the external solution rather than upon a unidirectional accumulation or depletion of a single ion species. Fossil bone, therefore, behaves in a manner fundamentally similar to living bone." Cook considered fluorine a probable exception, and later successfully used the fluorine method himself (Heizer and Cook 1952). While the free movement of ions in and out of a fossil bone renders it useless for absolute age determination by radiocarbon or other isotope method, it does not affect the validity of the relative age determination by means of the fluorine index.

Variation in Fluorine Index

While in most cases satisfactorily fulfilling their purpose of indicating relative ages, the analyses of fossil bones have revealed considerable variation in the fluorine index for bones which one has reason to think are contemporaneous, and have remained in the one site since interment. The full reasons for such variation have yet to be determined, but the following are suggested as factors:—

1. *Variation in the fluorine content of living bone.* Cook (1951) says living bone acts like fossil bone as far as ionic exchange is concerned. Therefore it is to be anticipated that in a fluorine rich area a person or animal would ingest comparatively large amounts of fluorine which would be trapped in the bones and accumulated in the same way as it is in fossil bones. Conversely, in a fluorine deficient area, a person or animal would be expected to have fluorine deficient bones. Evidence for this is found in the fluorine deficiency and fluorine excess (fluorosis) of teeth occurring in various areas. Brekhus and Armstrong (1935, quoted in Marston 1950) state that the mean fluorine content of human tooth enamel is 0.0111 per cent. and that of dentine 0.0169 per cent., while the pooled dentine of a patient with fluorosis showed 0.0504 per cent. fluorine. Mason (1952) states fluorine to be <0.05 per cent. of the body weight of organisms (p. 197). Olsen (1950) gives the percentage of fluorine in the Recent horse of Florida as 0.01. Oakley and Hoskins (1950) reported a fragment of fresh bone from the soil as having

<0.1 per cent. fluorine. Heizer and Cook (1952) record fossil human bones as having 0.01 per cent. fluorine, and Stewart (1952) a fossil bone with only 0.0071 per cent. fluorine. Non-fossil bone analyzed in the present series had 0.002 per cent. to 0.11 per cent. fluorine. From the information available it appears that:—

(*a*) There is considerable variation in the percentage of fluorine in living bone, and more information is needed about this.

(*b*) Theoretically, this could account in certain circumstances for considerable variation in the fluorine index of fossil bones from the same site and of the same age. For example, if a human or animal hunter caught some prey from the presumably fluorine-poor aeolianite of the coast, and some from the fluorine-rich basaltic tuff country nearby, and left bones from each in the same midden or the same lair, a great length of time would need to elapse before the initial difference in fluorine content became insignificant relative to the total quantity of fluorine in those bones. Also a fluorine-rich bone could be intruded thousands of years later into a deposit containing bones that were initially fluorine-poor, and yet have the same amount of fluorine as the older bones. When migrations of birds and animals are contemplated, it is conceivable that bones with very different initial fluorine content could be buried together. In most cases, one assumes, this kind of thing would not happen, but it seems reasonable to expect that the difference in the initial amount of fluorine in bones is one of the causes of variation in the F. index of bones known to be contemporaneous.

The present series of analyses suggests that there is not only difference in fluorine content from animal to animal according to their habitat, but also from part to part of the skeleton of the same animal. The differing fluorine indices of the jaw of the extant *Wallabia* (specimen 12) were obtained from different parts of the same bone, while in the case of the *Rattus* from the Keilor Skull site (specimen 23) the indices were from different groups of bones from the same skeleton. The differences are greater than the estimated range of experimental error, and it appears that the fluorine content varies in different parts of the same skeleton,

as some other substances are known to do.* Brekhus and Armstrong (1935) found differences between the dentine and enamel of the same teeth.

A series of analyses has been completed of the same part of the same bone of possums (non-fossil) of the same species (*Trichosurus vulpecula*) from widely separated parts of Victoria and Northern Tasmania (specimens 1 to 8). The results may be compared with those of bonedusts in three areas of Victoria (specimens 9 to 11). No correlation was found between the fluorine content of specimens 1 to 11 and the fluorine content of domestic water supplies in the four areas for which figures were available.

Another point worthy of investigation is whether the bones of marine animals possess more fluorine than the bones of terrestrial animals. And what of predatory animals, either terrestrial or marine, that ingest the bones of other animals? Do they thereby obtain an increased amount of fluorine? Do humans fond of sardines and soused fish, thereby ingesting the bones of marine animals, thus gain significant amounts of fluorine not gained by others?

2. *Variation in the fluorine environment of the fossil bone.* In any given homogeneous rock mass there is presumably little variation in the dissolved mineral content of the percolating waters. The position of a fossil bone relative to the water-table, however, may be important. A bone low in the formation might be bathed without interruption in a mineralizing solution, whereas one high in the same formation might be above the water-table and dry during the summer, or during comparatively arid periods. This is a possible source of variation in the fluorine content of fossil bones. The Keilor Terrace, whence came specimens 18 to 23, is of a porous silt standing high above the river. To the writer's knowledge, the skull site is never reached by the water-table and the ground is only saturated when heavy and continual rain falls. In the Arid Period it would receive still less water.

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* Since writing this paper, the work of J. M. Harvey (1952) on fluorosis of sheep in Queensland has come to my notice. Harvey has shown that in respect to certain experimental sheep—

1. The concentration of fluorine in bones and teeth is not proportional to fluorine intake.

2. In the bones examined, the fluorine storage is greatest in the mandible, then in the femur, tibia and metatarsus, in that order.

3. In the permanent incisor teeth, the fluorine storage in general increases from first pair to second pair to third pair.

4. For the premolars and molars, the fluorine content varies with time of eruption, being lowest in the second molar and comparable in the third premolar and third molar.

5. The fluorine concentration is much greater in dentine than enamel.

There is often a considerable difference in the amount of mineralization of contemporaneous fossil bones taken from cave deposits. Owing to the unequal spread of water in a cave, some bones may be heavily mineralized and even cemented into a cave breccia, while other bones may be comparatively fresh. So it may be imagined that different bones in the same cave, although of the same age, and even of the same skeleton, may have differing opportunities of trapping fluorine ions.

3. *Variation in the permeability of the fossil bone.* The figures given by Brekhus and Armstrong (1935), Oakley and Hoskins (1950), and Harvey (1952) for the fluorine content of the enamel and dentine of teeth suggest that the enamel is more resistant to the absorption of fluorine than dentine, presumably because it is less permeable. The more solid a bone becomes, the less permeable it may be. In the extreme case, if a bone is completely silicified, it becomes as impermeable as a quartz nodule.

4. *Variation through experimental error.* Where the same person carries out a series of analyses, setting a standard for the colour change for the end points of titrations, and so on, it would appear that for that series the experimental error should be less than 0.05 per cent. Some writers have given fluorine percentages to four decimal places, but all these cannot be significant. In the present series, the fluorine percentages have been rounded off to the nearest 0.05 per cent., except in the case of specimens 1 to 11 which were analyzed with a view to noting the small variations from place to place.

Victorian Fluorine Analyses

To Mr. W. R. Jewell, Chief Chemist, State Laboratories, Melbourne, and to his staff, the writer is indebted for their interest in this investigation and the analyses listed on page 111.

Where more than one determination was made from one sample, the results were averaged. Relevant data concerning the specimens analyzed are set out below. In no case were teeth used.

GROUP A. *Specimens* 1 *to* 12.—The ramus of a mandible of a young non-fossil *Wallabia* (P. 15761) was used as a control in the first series of fluorine analyses to get some idea how much fluorine living marsupial bone absorbs (specimen 12). The percentage was higher than anticipated, and repetition of the analysis still gave a high result, the reason for which has not yet been discovered. However, the analysis of the *Trichosurus vulpecula* series (specimens 1 to 8) and the commercial bonedusts (specimens 9 to 11) shows that the average percentage of fluorine in living animal bones in Victoria is comparable with that found in other parts of the world.

Specimen.	% F.	% P_2O_5	$\frac{\%\ F \times 100}{\%\ P_2O_5}$	Number of Determinations.
Group A.—Living.				
1 to 8 *Trichosurus vulpecula* (Kerr), silver-grey possum.				
1. Healesville, Victoria	0·033	24·9	0·13	1
2. Anakie Ranges, Victoria	0·060	26·3	0·23	1
3. Gelantipy, Victoria	0·047	25·4	0·19	1
4. Avoca, Victoria	0·032	25·2	0·13	1
5. Mansfield, Victoria	0·008	25·1	0·03	1
6. Ararat, Victoria	0·035	24·1	0·15	1
7. Flinders Island, Tasmania	0·002	..	<0·01	1
8. Wynyard, Tasmania	0·005	25·1	0·02	1
9. Bonedust (commercial), Bendigo	0·016	22·6	0·07	1
10. Bonemeal, Wangaratta	0·022	25·4	0·09	1
11. Bonedust, Ballarat	0·017	22·3	0·08	1
12. *Wallabia*	0·05	27·9	0·2	2
	0·10	26·9	0·4	2
Group B.—Warrnambool District.				
13. Tower Hill beach midden	0·15	28·2	0·5	2
14. Bushfield Axe site	1·70	28·5	6·0	1
Group C.—Camperdown District.				
15. Lake Bullenmerri	0·25	24·6	1·0	1
16. Lake Colongulac (surface bone)	1·85	28·7	6·4	2
17. Lake Colongulac (giant marsupial site)	1·95	24·6	7·9	1
Group D.—Keilor Skull Site.				
18. Keilor Skull (inside)	0·30	14·9	2·0	1
19. Keilor Skull (outside)	0·30	15·3	2·0	1
20. *Macropus* vertebra	0·35	18·8	1·9	1
21. *Vombatus* humerus	0·40	26·7	1·5	1
22. Bone fragment	0·85	29·7	2·9	1
23. *Rattus*	0·75	19·6	3·9	1
	0·50	11·3	4·4	2
Group E.—Hamilton District.				
24. cf. *Macropus*	1·95	24·8	7·9	1
25. Bone from Lower Pliocene marine shell bed	2·75	26·0	10·6	1
26. Bone from underlying nodule bed	3·20	29·7	10·8	1

Late Quaternary Fossils

GROUP B comprises two specimens from the Warrnambool District of Western Victoria associated with the ash spread of Tower Hill, a recent volcano (Gill 1950).

Specimen 13 (P. 15762) is a marsupial bone from the Koroit or Tower Hill beach aboriginal kitchen midden (Gill 1951*a*) dated by radiocarbon analysis as being 538 ± 200 years old (Libby 1951). The midden is on calcareous beach sand just above a buried shore platform of tuff and lapilli from the nearby Tower Hill volcano (Gill 1953*a*). This specimen is included because it ties up the relative dating by fluorine analysis with the absolute dating by radiocarbon analysis, and also because it provides a contrast with specimen 14, which comes from *under* the volcanic ash spread, *over* which is the midden whence came specimen 13.

Specimen 14 (P. 15763) is a macropodid jaw from the Bushfield Axe site (Keble 1947). On the right bank of the Merri River at Bushfield, north of Warrnambool, a farmer sank a hole eight feet deep in the river terrace to anchor a winch. Under hard tuff, in a layer of tuffaceous freshwater limestone, an aboriginal basalt axe with hafting groove was found along with some black shiny mineralized bones. The writer has since examined the site on a number of occasions, finding numerous bones, along with flake and bone implements, in the river deposits nearby (Gill 1953*a*). No outcrop of tuffaceous limestone was found in the tuff cliff of the river, so it may be part of a buried terrace on which there was an aboriginal feasting place. For the fluorine test, one of the bones collected by Keble from the excavation was used, because it came indubitably from under the tuff. Specimen 14 is associated with the same ash spread as specimen 13, but the sites are 7½ miles apart in a direct line, and specimen 13 comes from over the tuff while specimen 14 comes from under it.

The marked increase in the fluorine index of specimen 14 over specimen 13 is paralleled by the increase between specimens 15 and 17 from above and below (respectively) the Hampden Tuff in the Camperdown district. In both cases the degree of increase is greater than anticipated and apparently is due to a rich fluorine environment originating in the apatite of the basaltic tuff. Barth (1947) writes, "In basalts and gabbros fluorine is present as apatite . . . Great amounts of fluorine are exhaled by volcanic eruptions." The permeability of the tuff provides maximum opportunity for the ground water to penetrate and take the fluorine into solution.

GROUP C comprises three specimens from the Camperdown district of Western Victoria associated with the Hampden Tuff formation.

Specimen 15 (P. 15764) is a ramus of the mandible of *Macropus canguru* collected by the writer from the lacustrine terrace deposits surrounding the crater now occupied by the deep Lake Bullenmerri. Thus it is later than the tuff. Some of the bones from the lake have been found *in situ* but most are found on the beaches, sluiced by the lake from the terrace deposits. The bones are somewhat mineralized and generally reddish in colour.

Specimen 17 (P. 15766) comes from a small quarry on the east side of Lake Colongulac (see maps Gill 1951*b*, 1953*a*), whence have come the red, very heavily mineralized bones of extinct giant marsupials. A piece of marsupial bone was used for the fluorine test. A radiocarbon analysis is being made of *Coxiella* shells from the same quarry. The site is also of interest because from this same horizon came a jaw of a dingo, and the carved Colongulac Bone, both presumptive of the presence of man. The formation from which the fossils come is overlain extensively by the Hampden Tuff, but at the site whence came the bone for fluorine analysis, this has been stripped off and replaced by a dune of windblown lake sediment largely derived from the tuff. This material is also presumably rich in fluorine.

Specimen 16 (P. 15765) was included for check purposes. It is a ramus of a mandible of *Macropus canguru* found on the surface at the same site as specimen 17. The bone is heavily mineralized, but whitish and not red like the other bones. It was desired to ascertain whether it is part of the skeleton of a recent *M. canguru* quickly mineralized or a member of the fauna which included the extinct giant marsupials. Its fluorine index leaves no doubt that it belongs with the giant marsupials, and is probably a bone washed out by the lake waters and bleached on the shore. We can therefore conclude that *Macropus canguru*, the Great Grey or Forester kangaroo which is still living in Western Victoria, lived in the Camperdown District as a contemporary of the giant marsupials. The Pleistocene giants have now died out, as in other parts of the world, and indeed this process appears to be still in progress. At the present time the smaller marsupials are the more successful, and there is a tendency for the larger forms to die out. *Macropus canguru* did not exist in very great numbers in the Pleistocene judging by the fossils found, while *Macropus titan* was the dominant kangaroo numerically (Gill 1953*b*). In the Holocene, *M. titan* disappeared, and *M. canguru* became the dominant form in this area.

The Keilor Skull

GROUP D. Fossils are rare in the Keilor Terrace, but the following have been found and used for the fluorine analyses.

Specimen 20 *Macropus* vertebra (P. 15770). At the time the Keilor Skull was found, two vertebrae (P. 15770-1) were obtained, which prove to be of kangaroo. These fossils were collected by the workmen digging out the terrace silt for molding sand, and no accurate information could be obtained of their spatial relationships. Sediment extracted respectively from the spinal canals of these vertebrae, sediment from the Keilor Skull, and sediment from the Keilor Terrace itself were examined by Dr. A. W. Beasley, and found to be similar. "Two sources for the suite of heavy minerals are clearly indicated", the report reads, "one basic and fairly recent, and the other acidic and much earlier. The bulk of the heavy minerals in each sample appears to have come from basaltic rocks." The source of the acid minerals is the granodiorite at Broadmeadows which erosion has recently exhumed. From this granodiorite came largely the sands and gravels underlying the basalt. These, being eroded by the river, constitute second or later cycle materials, more worn than those from the basalt which covers the plain into which the river has cut. The bedrock of Silurian siltstones and sandstones provides a still older source.

Specimen 21 *Vombatus* (P. 15772). Half of a wombat humerus was found in 1951 by Mr. D. J. Tugby, Curator of Anthropology of the National Museum of Victoria. It came from the higher part of the terrace.

Specimen 22 (P. 15776). In January, 1953, Mr. F. S. Colliver observed a small fragment of bone in the Keilor Terrace at the skull site, and this was collected by the author. It came from three feet below the top of the terrace, and 35 yards west of the location of the skull.

Specimen 23 *Rattus* cf. *assimilis* (P. 15773). This fossil was collected by the writer in 1949 about 4 feet below the top of the terrace and 32 yards east of the location of the skull. The bones of the skeleton were together but slightly strung out. The picture given is of a rat washed down the river, then the skeleton disturbed by the accumulation of sediment as the soft parts decomposed. Thus the rat was buried when the sediments of the Keilor Terrace were laid down, and did not die in a burrow subsequently, i.e., it is contemporaneous with the terrace. The fluorine percentage is compatible with that of the other specimens from the same site, but unexpectedly high. The fluorine and phosphate percentages differ markedly for the two samples (different parts of the same skeleton), but the indices calculated from them are comparable. Since rats ingest the bones of other animals, they may gain extra fluorine in that way.

Specimens 18 *and* 19. *The Keilor Skull.* When Mahony reported the Keilor Skull, mention was made of a second skull (1943*b*, p. 31), and a signed statement (which included a reference to the second skull) by the contractor working the quarry was published. It has now been satisfactorily established that there was no second skull. The Chief Commissioner of Police for Victoria, Mr. A. M. Duncan, kindly had the whole matter of these human remains officially investigated. The contractor's statement arose apparently from his lack of knowledge of the bones concerning which he signed, and the statement was not made out by him.

Samples of about a quarter of a gram were used for all the fluorine analyses reported in this paper, except those from the Keilor skull which were as follows:—

Specimen 18. Inside of right petrous temporal .. 0.09 gm.
Specimen 19. Outside of right squamous temporal 0.05 gm.

Keilor Skull is not a Burial

Finding the age of the Keilor Terrace greater than he assumed it to be theoretically, Keble found " reason for believing that the skeleton may have been a burial " (Keble and Macpherson 1946, p. 52). The area has been re-studied geologically, and the age of the terrace can be stated to be less than originally calculated (Gill 1953*c*). A full report is in preparation. From the following evidence it appears certain that the skull was not a burial:—

(*a*) The fluorine analyses show that the skull possesses an F. index comparable with those of fossil *Macropus, Vombatus,* and an indeterminable bone from the same terrace at the same site.

(*b*) The skull was found minus the lower jaw and minus most if not all the rest of the skeleton. Fragments of two femora were found at the time the Keilor Skull was discovered, but although these have been stated to be human, and have been so listed, the anatomists advise me that this has not really been established. Even so, far more complete remains would be expected if this were an aboriginal burial.

(*c*) The Keilor Skull was approximately 9 feet from the surface of the terrace when found, about 25 feet in a direct line from the bank of Dry Creek, and a similar long distance from the bank of the Maribyrnong River. These distances are too great from which to effect an aboriginal burial (Gill 1953*d*).

(*d*) The amount of mineralization of bones in the Keilor Terrace varies considerably, but the Keilor Skull exhibits the maximum amount found at that site. Two to over four millimetres of encrustation is found both inside and outside the skull, although this has now been chipped from most of the exterior surface, a thin layer of calcite can be seen lining small cavities and occupying the fine space between the alveolus and tooth in some instances.

(*e*) In places the Keilor Skull shows evidence of abrasion. For example, the left zygomatic arch was broken before mineralization (see photo of uncleaned skull, these Memoirs 13, plate I., fig. 2, and compare plate IV., fig. 2), and the posterior end of it is rounded and smoothed. This and other similar abrasion shows that the skull was a piece of sedimentary material before final burial—a natural and not a manmade interment. The small degree of abrasion, however, shows that the skull was not moved far.

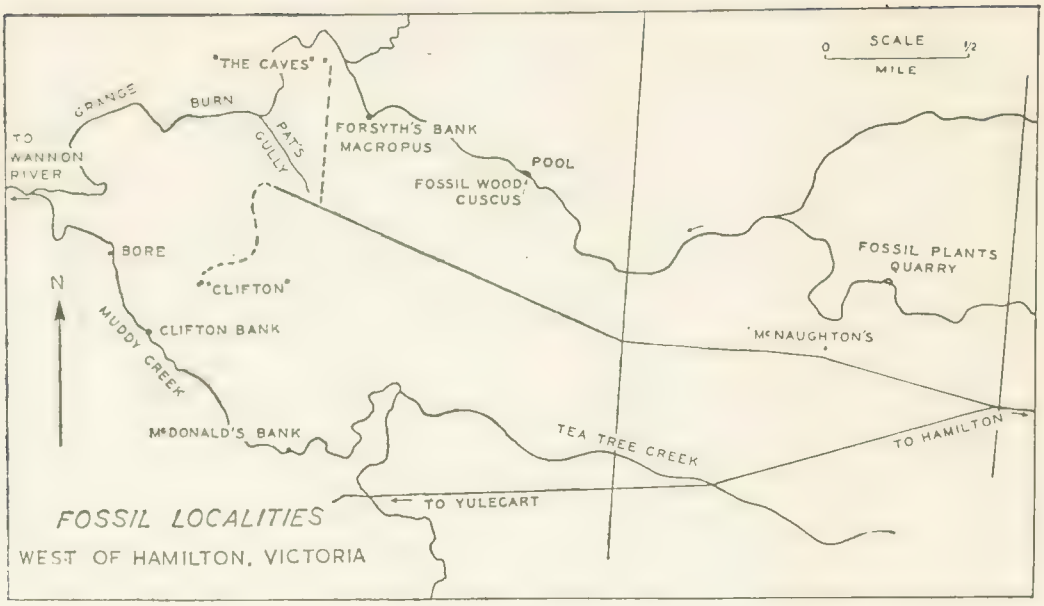
(*f*) Just above where the Keilor Skull came from in the terrace is an important diastem or minor disconformity. The " sinuous band of greyish-red sand, about 2 inches thick, in which are thin layers of calcined bones, ashes, and fragments of red ochre " referred to by Keble (1946*b*, Keble and Macpherson 1946) appear to have been associated with this sedimentational break. Even if the skull were a burial, the above materials and the quartzite flake extracted from them by Professor E. S. Hills (Mahony 1943*b*, Keble and Macpherson 1946) are good evidence of human occupation. According to the memories and notes of those who first saw the excavation, the skull was not found in contact with the layer of ash, &c., but a few feet from it.

The discovery of the skull happened in war time, and investigations that normally would have been made could not be carried out. However, it can now be taken as established that *there was only one Keilor Skull, and that its age is that of the river terrace in which it was discovered.*

Tertiary Marsupials

GROUP E is a suite of three specimens analyzed to test the validity of a Tertiary marsupial fossil, which is the only published record of an Australian Tertiary marsupial apart from *Wynyardia bassiana* from the marine bed at Fossil Bluff, between the town of Wynyard and Table Cape on the north coast of Tasmania. The Tertiary deposit at Fossil Bluff rests on a platform of Permian tillite, the surface of which is only a few feet above low tide level. At the base of the Tertiary sediments is a calcareous conglomerate consisting of many kinds of rocks derived from the tillite, plus small quartz pebbles and sand, plus a large number of Tertiary shells, mostly fragmentary (the *Crassatella* Bed of Johnston 1876, who recorded fossil wood therefrom). This grades into a highly fossiliferous yellow clayey limestone (the *Turritella* Bed). In the higher part of the cliff the marine fossils almost disappear, and near the top some leaves of land plants have been found along with a few broken and worn shells. In the National Museum is a piece of fossil resin (P. 15778) from this cliff, obtained from R. M. Atkinson in 1911. The Fossil Bluff is capped with basalt, and the sea constantly attacks the cliff, keeping the base clear. *Wynyardia* was found in the *Turritella* bed. There is no diastem in the Tertiary succession at Fossil Bluff, and the beds are considered to all belong to the one phase of sedimentation. The conglomerate at the base suggests rejuvenation and submergence, while the reduction of marine fossils and the appearance of leaves of land plants at the top (although the bed is still marine or estuarine) suggests emergence. The general facies is near-shore, and the presence of *Wynyardia*, wood, resin, and leaves suggests the proximity of a river down which these were washed. *Wynyardia* is a possum quite like *Tricohosurus* (Wood Jones 1930), so much so that some have wondered why a new genus and family were erected to accommodate the species. It has generally been agreed that the age of the Fossil Bluff beds is Janjukian, which Singleton (1941) regarded as Upper Oligocene to Lower Miocene, but Raggatt and Crespin (1952) now consider to be Upper Eocene. *Wynyardia bassiana* is therefore a middle or lower Tertiary possum, probably washed down a river and interred in near-shore marine deposits.

A somewhat similar history seems to belong to an upper Tertiary kangaroo, a fragment of which has been found in a marine bed exposed on the Grange Burn near Hamilton, Western Victoria. The section is a well-known one called Forsyth's Bank (Chapman 1914, Singleton 1941). See text-figure 1. At the foot of the bank is a shell bed of Lower Pliocene



TEXT FIGURE 1.

age, and from it Mr. A. C. Frostick and Mr. F. S. Colliver collected part of a mandibular ramus (Plate 1, figs. 5-8), which has been recorded by Colliver (1933) thus:—

> "The most interesting specimen was collected by Mr. Frostick, and is portion of the right ramus of a wallaby (*Halmaturus?*). This is approximately 2 inches long and contains one perfect molar tooth. It was obtained *in situ* in the midst of the shell bed, and about 2 feet from the surface of the deposit." (P. 71.)

This fossil was given to the Department of Geology, University of Melbourne (reg. No. 2019), and through the kindness of Professor E. S. Hills, the writer has been able to study it, and carry out a fluorine test on it. Doubts have been expressed, although not published, on the validity of this fossil, because it came from a marine bed, and one of Tertiary age. The writer has checked the circumstances of its collection, and there is no doubt that it was collected from the compact shell bed at the foot of Forsyth's Bank. Both the above-mentioned gentlemen saw the fossil in place, and one watched the other remove it. The fluorine test now confirms their evidence.

Some matrix was removed from this fossil before it was photographed. It came mostly from the tooth cavity (Plate 1, fig. 6), but also from around the base of the preserved tooth. This matrix was noted to be the same type of material as constitutes the Forsyth's Bank shell bed. The foraminifera from the matrix were kindly examined by Mr. A. C. Collins, who reports that

Elphidium pseudonodosum Cushman is included (Slide P. 15756). This species was described by Cushman from material collected by Parr from Forsyth's Bank, i.e., the same locality as the fossil kangaroo. Parr (1939, p. 69) says that this species "has not been found elsewhere than in the Kalimnan of the Hamilton District." The common Kalimnan foram *Elphidium imperatrix* (Brady) is probably also present.

The history of this macropodid jaw, its matrix, the attached foraminifera, and the fluorine analyses all join to dispel any doubts about its origin. It is of the same age as the Forsyth's Bank shell bed, i.e., Kalimnan, Lower Pliocene.

Specimen 26 (P. 15767) is a rounded and polished piece of bone, probably whalebone, dug by the writer from the nodule bed which underlies the above-mentioned shell bed. It was obtained from the upstream edge of the pool at the foot of Forsyth's Bank, i.e., about a chain from the site of specimens 24 and 25. The nodule bed used to outcrop at the foot of Forsyth's Bank, but the 1946 flood deposited débris which partly blocked the stream, placing the outcrop under 2 feet of water. Specimen 26 is remarkable for having 3.2 per cent. fluorine, and a fluorine index of 10.8.

Specimen 25 (P. 15768) is a piece of bone, highly mineralized, found after a long search in the shell bed at Forsyth's Bank. The fluorine index of this specimen is near that of the bone from the nodule bed, and invites the thought that it is derived from it. This could easily have happened.

Specimen 24 is the piece of macropodid jaw referred to above. It is a piece of a mandibular ramus of a young kangaroo, preserving the third molar, and is regarded as belonging to the genus *Macropus* in the broad sense. The bone gave a fluorine index of 7.9, which although less than that of specimens 25 and 26, is high enough to prove that it is an ancient fossil, and not a bone recently introduced in some way into the shell bed. If specimens 25 and 26 both originate in the nodule bed, which rests directly on Balcombian clay, then some such difference in the fluorine index is to be anticipated.

The fragment of macropodid ramus which constitutes specimen 24 is highly mineralized, and like the other bones of Group E. contains a good deal of iron, judging by its yellowish-brown colour. In this bone there is one complete tooth, a 3rd molar, anterior to which are the roots of another tooth, and anterior to that again is a tooth root cavity. The molar is 8 mm. wide and 11 mm. long, hypsodont and sharply bilophodont, having

two high transverse ridges, 5 mm. apart. There are clearly developed but not very high longitudinal ridges, one connecting the transverse ridges, and one on the small platform (1½ mm. long) anterior to the more forward transverse ridge. The connecting ridge rises a maximum of about one third of the depth of the low area between the transverse ridges.

The fossil is clearly of the *Macropus* type, and a young animal. It has the specialized molar pattern of grassland inhabitants. The marine shell bed in which it was found is a nearshore deposit, with the foram *Epistomaria polystomelloides* common in it, and *Amphistegina radiata* in another outcrop of the same bed, indicating warm water conditions (*vide* Parr 1939), but not as tropical as in the preceding Balcombian times. The ecological picture is of a sub-tropical grassland or open forest from which a young kangaroo was swept (probably down a river) into the sea. Its skeleton disintegrated, and all that remains now to our knowledge is the fragment of the lower jaw described above.

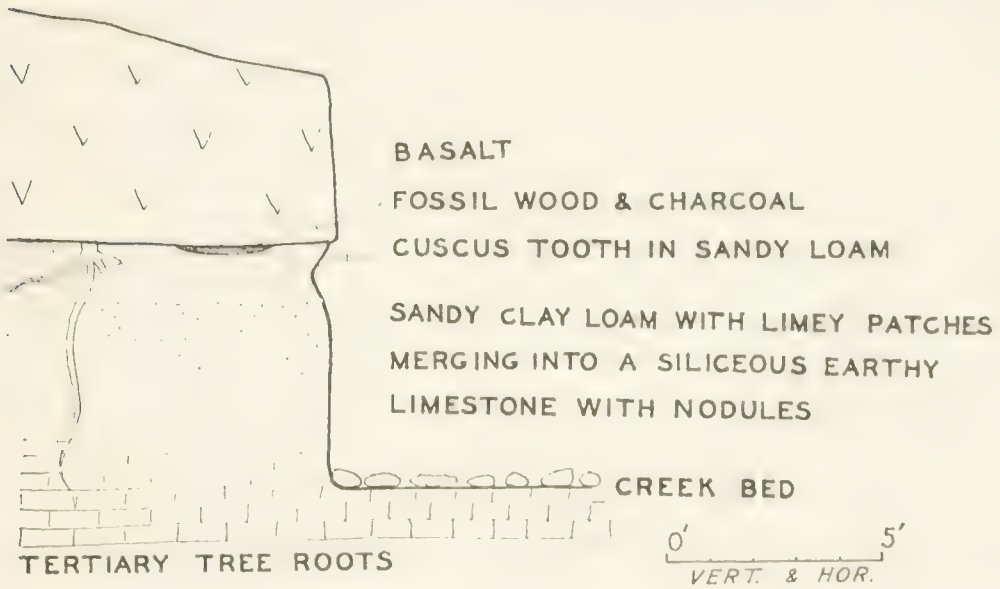
Evolution of the Kangaroos

Although of Lower Pliocene age, the Forsyth's Bank kangaroo is a specialized grassland animal. Raven and Gregory (1946) say, "Notwithstanding the great differences between the primitive *Hypsiprymnodon* and such highly specialized genera as *Macropus, Dendrolagus,* and *Sthenurus,* the survival in the existing and Pleistocene faunas of so many living fossils, together with the failure of any of the kangaroos to spread from New Guinea into Malaysia, suggests a relatively late geological date (middle to late Tertiary) for the origin of the family from phalangers akin perhaps to the Pleistocene *Burramys.*" The kangaroo from Forsyth's Bank proves that the Macropodidae evolved before the late Tertiary. As Australia has been a biological asylum for more than 70,000,000 years with no competition from the newer and more efficient placental mammals, it is not surprising that there are many "living fossils." Spread of the kangaroos from New Guinea to Malaysia could not take place because of the ocean deep effectively separating the two areas over a long period of time.

Tertiary Cuscus

Above the Kalimnan (Lower Pliocene) shell bed with the fossil kangaroo jaw at Forsyth's Bank on the Grange Burn there is a yellow limestone which has been leached so as to remove the aragonitic shells, of which casts and molds survive, but leaving the calcitic ones. The limestone is quite crystalline in places due to redeposition of calcium carbonate, probably a function of a

podsolizing process. This bed is a shallow water one, and further upstream it becomes glauconitic, pebbles become common, and strong current bedding is present. Exhumed porphyry rock stacks are also there. The top of this limestone has been weathered into a podsolozed soil, and is now sealed off with a basalt flow which also preserves Tertiary plants in position of growth (Gill 1952). Where the Grange Burn flows off the basalt on to the Tertiary



TEXT-FIG. 2. Occurrence of Pliocene cuscus on the south bank of Grange Burn, near Hamilton, Victoria.

rocks, there is a pool on the south side of which the section shown in text-figure 2 occurs. From the firm and undercut fossil soil 6 inches under the basalt a fossil tooth was dug out by the writer. The tooth has now been cleaned, and what there was of the root of the tooth crumbled away with the matrix, leaving only the crown. It can be seen from Plate 1, figs. 1-4 that there are poorly developed transverse and connecting ridges, but the tooth is essentially of the quadricuspid type. It is an upper molar of an adult, and the maximum diameters are 8 mm. by 8.5 mm. Mr. C. W. Brazenor, the Curator of Mammals of the National Museum of Victoria, has kindly studied this tooth (reg. No. P. 15777) with me, and the nearest living animal with which it can be compared is the cuscus. This fits the rain-forest habitat suggested by the accompanying fossil flora which includes *Phyllocladus* and *Araucariacites*. Evidence has been given for regarding this bed as Upper Pliocene in age (Gill 1952). De Vis (1889) recorded a giant fossil cuscus from Queensland Post-Tertiary rocks.

Australian Tertiary Marsupials

The Grange Burn Tertiary beds have thus yielded a Lower Pliocene kangaroo and an Upper Pliocene cuscus. The stratigraphical relationships of the known Australian Tertiary marsupials is given in text-figure 3. It is of interest to note that

	Time.	Fossils.	Ecology.
Quaternary.	Holocene.. ..	Fauna similar to the present ..	Varied
	Pleistocene ..	Giant extinct marsupials and forms similar to the present	Varied
Tertiary.	Upper Pliocene ..	cf. Cuscus	Rain forest
	Lower Pliocene ..	cf. *Macropus* (Kangaroo) ..	Grassland or open forest
	Miocene	Forms recently found but not yet reported	
	Oligocene to Eocene	*Wynyardia* (Possum)	Forest

Text Figure 3.

the only three known Australian Tertiary marsupials (the above two and *Wynyardia*) are herbivores (two phalangerids and one macropodid), all are diprotodonts, and all comparable in size with their extant congeners.

Fluorine Distribution

The ranges of fluorine content for the various geological periods concerned are:—

	% Fluorine	Fluorine Index
Extant	0.002–0.10	<0.01– 0.4
Holocene	0.15 –1.70	0.5 – 6.0
Pleistocene	0.30 –1.95	1.5 – 7.9
Tertiary	1.95 –3.20	7.9 –10.8

Both fluorine percentages and fluorine indices have an overall increase with age. The bones whose fluorine content is high for their geological age are those from the Bushfield site and from the Lake Colongulac site. In both cases they are under basaltic tuff containing apatite.

Description of Plate 1.

The fossils were coated with ammonium chloride, then photographed by Mr. L. A. Baillôt of the Melbourne Technical College, to whom I am indebted for his expert assistance. None of the photographs has been retouched.

Fig. 1. cf. *Cuscus* from fossil soil, Grange Burn, Victoria. Pliocene, probably Upper Pliocene, × 4.

Fig. 2. Same as fig. 1, but natural size.

Figs. 3–4. Same tooth, oblique view. Fig. 3 natural size, fig. 4 × 4.

Fig. 6. cf. *Macropus* from marine shell bed, Grange Burn, Victoria. Lower Pliocene. × 4.

Figs. 7–8. Same as fig. 6, but lateral view. Fig. 7 is natural size, while fig. 8 is × 4.

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PLATE 1.

ON A SMALL QUANTITY OF SIPHONARIA MATERIAL FROM QUEENSLAND

By Bengt Hubendick, Riksmuseum, Stockholm, Sweden

Plate 1, Figs. 1–8

Since the publishing of my " Systematic Monograph of the Patelliformia " many malacologists have sent material of this group to me for identification. In addition, I have studied the rich material of Patelliformia in the museum of natural history in Brussels, most of which originating from the Dautzenberg collection. And always I have been met with the same impression, namely that there is a wide intra-specific variation and that, often, it is very difficult to delimit related species from one another. The main purpose of this paper and particularly its part dealing with *Siphonaria virgulata* is to stimulate the Australian malacologists to a close study of variation, possible geographical races, and species delimitation from a modern systematic point of view, of the Australian forms of *Siphonaria*.

SIPHONARIA (PACHYSIPHONARIA) VIRGULATA HEDLEY from Currumbin, Queensland (six specimens, National Museum of Victoria, F. 13952).

A description of *S. virgulata* is given by me (1946 p. 23). The specimens from Currumbin, however, differ in many details from that description. The number of radial ridges is still higher, and the ridges are still finer and situated still more densely together. The edge is hardly scalloped at all. The outline is somewhat darker than in all specimens from other localities I have seen. The inside is considerably darker, only a central spot being bluish or brownish white. In a narrow zone on the inside and along the edge there are short and slender white radii corresponding to the radial ridges on the outside. Inside this zone there are concentric dark-brown or black zones reaching the pale apical spot. Even the muscle impression is dark. The ventral side of the foot is uncoloured, its sides being pale-gray with white dots, the latter probably corresponding to glands. The pallial border has faint pale-gray spots.

The morphology of the distal genitalia (figs. 1–2) confirms that the population represents a form of *S. virgulata* or a very closely related species. In two dissected specimens there was a spermathophore in the accessory organ. The spermatophore has a rather clumpsy form and consists of a comparatively thick, chitinous wall. One half of the structure is regularly cylindrical with a bluntly pointed end. The other end is somewhat irregularly shaped with at least one blunt process. One end of the spermatophore is in close contact with the wall of the

accessory organ. The epithelium of this very small portion of the wall consists of extremely long and slender cells with invisible nuclei. It seems possible that this epithelium contributes to the formation of the chitinous spermatophore.

The radula of the Currumbin form differs in some details from those of previously studied specimens. According to my experience of intra-specific variability of the radula in Basommatophora in general the present differences cannot be motive enough to separate the Currumbin population as a distinct species.

All previously known findings of *S. virgulata* are from New South Wales. In the natural history museum of Brussels there are also two lots from Tasmania. The population from Currumbin, Queensland, dealt with here, seems to represent an isolated occurrence to the north of the main distribution area of the species. If that is true the aberrant characteristics of the Currumbin specimens may be due to geographical isolation and the population may represent a geographical race of *S. virgulata*. I do not find it appropriate, however, to name this possible race until its relation to the main form of *S. virgulata* is known. It would be appreciated if an Australian malacologist tried to obtain a series of populations of *S. virgulata* from the Sydney area to Currumbin or even still further northward. A critical examination of the material obtained may show whether the various characteristics of the species have irregular or spotted distributions along the coast or they form gradually changing clines. The method of procedure to be used in working out the material is shown in a previous paper (Hubendick 1950).

SIPHONARIA (SIPHONARIA) SAVIGNYI PHILIPPI from Woody Point, Moreton Bay, Queensland (one specimen, National Museum of Victoria, F. 13951).

The specimen is comparatively big, 31 mm. in length. With the exception of the size and the inside coloration the shell fits well to the description in Hubendick 1946. Inside, along the margin, there are short brown radii corresponding to the interspaces between the ridges on the outside. Further inside, but peripheral to the muscle impression, many of the brown radii join each other, forming a brown zone. From the muscle impression and inwards the colour is bluish and centrally it is pale-brown. The dorsal side of the body of the animal is grayish, the rest of the animal is somewhat dirty-yellow.

In my monograph *S. savignyi* is given only from the Red Sea and the Gulf of Suez. In the Dautzenberg collection in Brussels, however, there is one specimen from New Caledonia. The last mentioned occurrence makes the finding from Queensland less astonishing.

SIPHONARIA (SIPHONARIA) ATRA PILSBRY from Woody Point, Queensland (three specimens from National Museum of Victoria, F. 13951; Cairns Reef, North Queensland, one specimen from same collection, F. 820).

This form, which agrees with Iredale's *eumelas,* is without doubt included in the range of variation of *S. atra.* The species is previously known from Queensland. It is common in the East Indies and known from Madagascar to Fiji.

The specimen from lot No. 820 which has to be classified as *S. atra* differs completely from the remaining specimens from the same lot. Previously they have all been classified as *S. bifurcata* Reeve by Sowerby (see below) but the lot is undoubtedly heterogenous.

FURTHER FORMS OF THE INDIAN–WESTPACIFIC FORM-GROUP.

In the "Monograph of the Patelliformia" (1946, § 72) I defined the Indian–Westpacific form-group. This comprises a number of forms, some of them may be species, which are highly variable and connected with one another through series of transitional forms. Since then I have examined several museum collections of *Siphonaria* and also living populations in the Philippines. It becomes more and more evident that the taxonomical conditions in the Indian–Westpacific form-group (as well as in some other form groups of *Siphonaria*) are extremely obscure. Studies of the background of variation and speciation within the group and examination of big numbers of population samples are necessary to unravel the tangle in a proper way.

Among the Queensland species involved in the Indian–Westpacific form-group are Iredale's species *marza, zanda,* and *oppositus.* The form from New Caledonia named *commixtus* by Iredale but never described belongs to the same form-group. Another member is *luzonica* Reeve. The distal genitalia of this species from Rottnest Island, West Australia (National Museum of Victoria F. 13940) are figured in fig. 3. Even *S. atra* Pilsbry (see above) and related forms may belong to the same group.

The following lots from National Museum of Victoria are Queensland representatives of some of the above-mentioned forms or close relatives to them: Yorkey's Knob, Cairns (F. 15030, 5 spms.); Heron Island (F. 15035, 3 spms.); Shoal Point, Mackay (F. 15036, 2 spms.); Airlie's Landing, Cannonvale (F. 15037, 3 spms.); Yorkey's Knob, Cairns (F. 15039, 2 spms.); Cape Edgecumb, Bowen (F. 15042, 3 spms.). I find it most appropriate not to attach any names to these specimens at present.

SIPHONARIA (SIPHONARIA) BIFURCATA REEVE from Cairns Reef, North Queensland (three specimens from National Museum of Victoria, F. 820).

These specimens look like a transitional form between *S. zanda* and *S. savignyi*. The specimens have, however, been identified previously by Sowerby as *S. bifurcata* Reeve. As Sowerby with all probability compared the specimens with the type in the British Museum this identification has to be accepted, though it does not fit at all to the description of *S. bifurcata* by Reeve 1856. On my request Dr. Rees at British Museum kindly compared the specimens with the holotype. He confirmed Sowerby's determination as far as the two last mentioned specimens are concerned. This means that *S. bifurcata* in my previous papers on *Siphonaria* (1945, 1946) actually corresponds to another species. Further, the identity of *S. bifurcata* seems to have been misunderstood in many European collections.

S. bifurcata Reeve is identical with the species *S. kurracheensis* Reeve in my previous papers. This species belongs to *Siphonaria s. str.*

As "*S. bifurcata*" was selected as type species of *Ductosiphonaria* this group name becomes a synonym of *Siphonaria s. str.*

Basing on the anatomically verified belonging of my "*S. bifurcata*" to "*Ductosiphonaria*" and the close relationship between this species and *S. baconi* Reeve I concluded that also the latter species must belong to "*Ductosiphonaria.*" An examination of the type of *S. baconi* in British Museum verifies the close relationship between this species and the form dealt with as *S. bifurcata* in my monograph (1946 p. 37). The two forms may possibly be even specifically identical.

SIPHONARIA (PLANESIPHON) ZEALANDICA QUOY AND GAIMARD from Caloundra, Queensland (two dry and three alcohol specimens from National Museum of Victoria, F. 13873).

Syn.: *S. zebra* Reeve 1856.
Planesiphon elegans Iredale 1940.
S. (*Ductosiponaria*) *bifurcata* Reeve 1856 in Hubendick 1945 and 1946 p. 37.

After having seen the type of *S. zealandica* Q. and G. in Paris (the locality "New Zealand" of the type is probably erroneous), *S. zebra* Reeve in London and a borrowed paratype of *S. elegans* Iredale it appears obvious that these species are identical with the one dealt with under the name "*bifurcata Reeve*" in my

previous papers. As *bifurcata* Reeve has proved to be another species, belonging to *Siphonaria* s. str., Quoy and Gaimard's name has to become the valid name for "*bifurcata*" in my publications.

McAlpine (1952) pointed out that Iredale's *elegans* and the species in my papers identified as *elegans* could not be the same. They were even anatomically different. The latter belong to *Siphonaria* s. str. and is probably a new species. McAlpine found, however, that the real *elegans*, i.e. *zealandica* Q. and G. and "*bifurcata*" in my papers, does not even fit the anatomical characteristics of *Ductosiphonaria*. The species under consideration was designated as type species of that section by me. I have dissected specimens of *zealandica* from Caloundra and found that McAlpine is right. I have also dissected more specimens from Port Jackson, specimens of the same lot as I used for my previous studies. The genitalia of these agreed with McAlpine's description and with those of *zealandica* from Caloundra. The material from Port Jackson must have been heterogenous and a few animals, the shells of which were not included in the sample, belonged to *Ductosiphonaria diemenensis* Quoy and Gaimard. That is the only way of explaining the contradicting results.

The reproductive system of *S. zealandica* is figured and briefly described by McAlpine (1952) as belonging to *Ductosiphonaria bifurcata* (Reeve). His figure and description is schematic and some details of importance for the classification are not included. Some complimentary notes will be given here.

Only the distal genitalia of this species are of importance for comparative purposes. Parts of these distal genitalia differ, however, from all other anatomically known *Siphonariidae*. *S. zealandica* has something like a genital athrium (figs. 5–6) which is formed by the distal continuation of the epiphallus duct. The gonoduct and the spermathecal duct open out into a thin-walled chamber which, in its turn, is communicating with the junction between epiphallus duct and genital athrium through a fairly narrow opening. The cross-section through the epiphallus-duct (fig. 7) shows a structure similar to that, which is characteristic for all species belonging to the subgenus *Siphonaria*. It has a thin, peripheral musele sheath, an incomplete layer of connective tissue and its lumen is covered with a partly ciliated epithelium. The central wall has one big and two smaller folds. The spermatophore, finally, consists of a simple, roughly cylindrical sac, which tapers fairly abruptly and continues with a slender, terminally pointed, appendix (fig. 8).

Siphonaria zealandica Q. and G., though being identical with "*bifurcata*" in my previous papers, i.e. the type species of *Ductosiphonaria*, does not belong to that group. Consequently

its systematical position and sectional name must be reconsidered. The name *Ductosiphonaria* is excluded by two reasons. As *S. bifurcata* Reeve has proved to belong to *Siphonaria* s. str. (see above) the name *Ductosiphonaria* remains only as a synonym of *Siphonaria* s. str. Further, *S. zealandica* must be separated from *S. diemenensis* Quoy and Gaimard, the second species originally included in the group *Ductosiphonaria*, and placed in a group of its own. *S. elegans*, the oldest synonyme of *S. zealandica* given a new group name, was originally described under the generic name *Planesiphon* Iredale (1940). That name, however, did not become valid as Iredale omitted to designate a genotype. But McAlpine (1952) designated *S. elegans* as the genotype of *Planesiphon* and considered the latter as a synonyme of *Ductosiphonaria*. The last name, having lost its validity, must be replaced by *Planesiphon*. It cannot, however, remain as a genus but as a section. Iredale gave a diagnosis of *Planesiphon* based on specific characteristics only.

The section *Planesiphon* is characterized by the presence of a genital athrium, a chamber in which the gonoduct and the epiphallus duct meet before entering the genital athrium, and an epiphallus duct with a histological structure of the same type as in the subgenus *Siphonaria* in general.

The genitalia of *S. zealandica* differ from those of the sections *Simplisiphonaria, Hubendicula* and *Heterosiphonaria* in the first place by having a well developed genital athrium. Similarly to the condition in the section *Sacculosiphonaria* the gonoduct and the spermathecal duct meet before entering the genital athrium. There is a slight possibility that the chamber in *S. zealandica*, which the gonoduct and spermathecal duct enter, is homologous with the muscular sheath in the sections *Sacculosiphonaria* and *Siphonaria* s. str. The spermatophor in *S. zealandica* differs from that in *S. japonica* of *Sacculosiphonaria* but that difference is merely of specific range as different types of spermatophore occurs for instance within the section *Siphonaria* s. str. The taxonomical position of *Planesiphon* will be in subgenus *Siphonaria* and not far from the section *Sacculosiphonaria*.

Siphonaria (*Hubendicula*) *diemenensis Quoy and Gaimard.* No new material.

McAlpine has found and I have confirmed that neither the nominal type species of *Ductosiphonaria*, " *S. bifurcata* Reeve ", nor the species I identified as *bifurcata* Reeve, i.e. *S. zealandica* Q. and G., belong to the anatomically defined group *Ductosiphonaria*. This group name could not remain valid unless *S. diemenensis* Q. and G. was designated as type species. McAlpine prefers, however, to substitute the new name *Hubendicula* for *Ductosiphonaria* and designates *S. diemenensis* as the type species.

The taxonomic value of *Hubendicula* cannot be generic, as McAlpine has proposed. The genus *Siphonaria* is too uniform to be split up in different genera and *Hubendicula* has to be considered as a section within the subgenus *Siphonaria*. The second subgenus within the genus *Siphonaria* is *Liriola* Dall (cf. Hubendick 1946). Further, the characteristics McAlpine uses in his diagnoses of *Hubendicula* and *Ductosiphonaria* are in most items of merely specific value.

SIPHONARIA (SIPHONARIA) LACINIOSA (LINNE) from Yorkey's Knob, Cairns, Double Island near Cairns and from Cairns Reef, Northern Queensland (National Museum of Victoria, F. 15031, F. 13925, and F. 13923 respectively).

All specimens are typical but of different forms, those from Yorkey's Knob and Cairns Reef representing forma *exigua* and the one from Double Island forma *sipho*. Iredale's *Legosiphon optivus* from Magnetic Island, Queensland, is identical with *S. laciniosa*.

SIPHONARIA (SIPHONARIA) RUCUANA PILSBRY (?) from Etty Bay, Queensland and Cape Edgecumb, Bowen, Queensland (National Museum of Victoria F. 15040 and F. 15041 respectively).

The determination is not completely certain. *S. rucuana* is originally described from Riukiu Island. In the collection of Institut Royal des Sciences Naturelles de Belgique in Brussels there are both dry and spiritus material of *S. rucuana* from the Seychelles. An examination of the genitalia shows that the species belongs to *Siphonaria* s. str.

SIPHONARIA (SIPHONARIA) AUSTRALIS QUOY AND GAIMARD from Masthead and Heron Islands, Capricorn Group, Queensland (National Museum of Victoria, F. 13924, F. 15032, F. 15034, and F. 15038).

S. australis is originally described from New Zealand but is known also from Australia and some smaller islands in the Southwestern Pacific. The specimens from Masthead Island are small and pale brown. The main radial ribs are well elevated. The underside is uncommonly pale, only the area just inside the muscle impression being brown. It is possible that the Queensland populations of *S. australis* are racially separated from those of other areas. If so its complete name should be *S.* (*S.*) *australis* Q. and G. *promptus* Iredale. A rich material from many localities, however, is necessary to allow a definite conclusion in this question. The Capricorn population does hardly represent a sort of microgeographical race because similar forms are obtained from two different islands in the group.

SIPHONARIA (SIPHONARIA) CURRUMBINENSIS N. SP. from Currumbin (type locality), Queensland and from Noosa, Queensland (ten specimens in all, six in alcohol; National Museum of Victoria, F. 13953 and F. 13948 respectively). Type F. 15562 in National Museum of Victoria.

Shell medium large, medium high. Upper side with about 35 radial ribs, about fifteen of which are predominating. Between the ribs sometimes still finer radial riblets. The very slightly projecting siphon formed of two ribs, sometimes with a third, narrow rib between the two. A very minute concentric sculpture may be present. The small, pointed apex is turned backwards and slightly to the left. The embryonic shell, when present, continues to the right. The apex is dark, the interspaces are brownish and the ribs white or very pale-brown. Interior with white spots or short radii corresponding to the ribs. Inside and between these spots is a dark-brown or black zone. The muscle impression is sometimes purplish-grey, sometimes not distinguished from the surrounding by colour. The centre is brown. Yellow rays sometimes radiate from the centre, particularly through the siphonal groove and in a frontal direction.

The foot and the head of the animal is pale. The mantle border has dark spots and parts of the dorsal side of the animal is dark-gray.

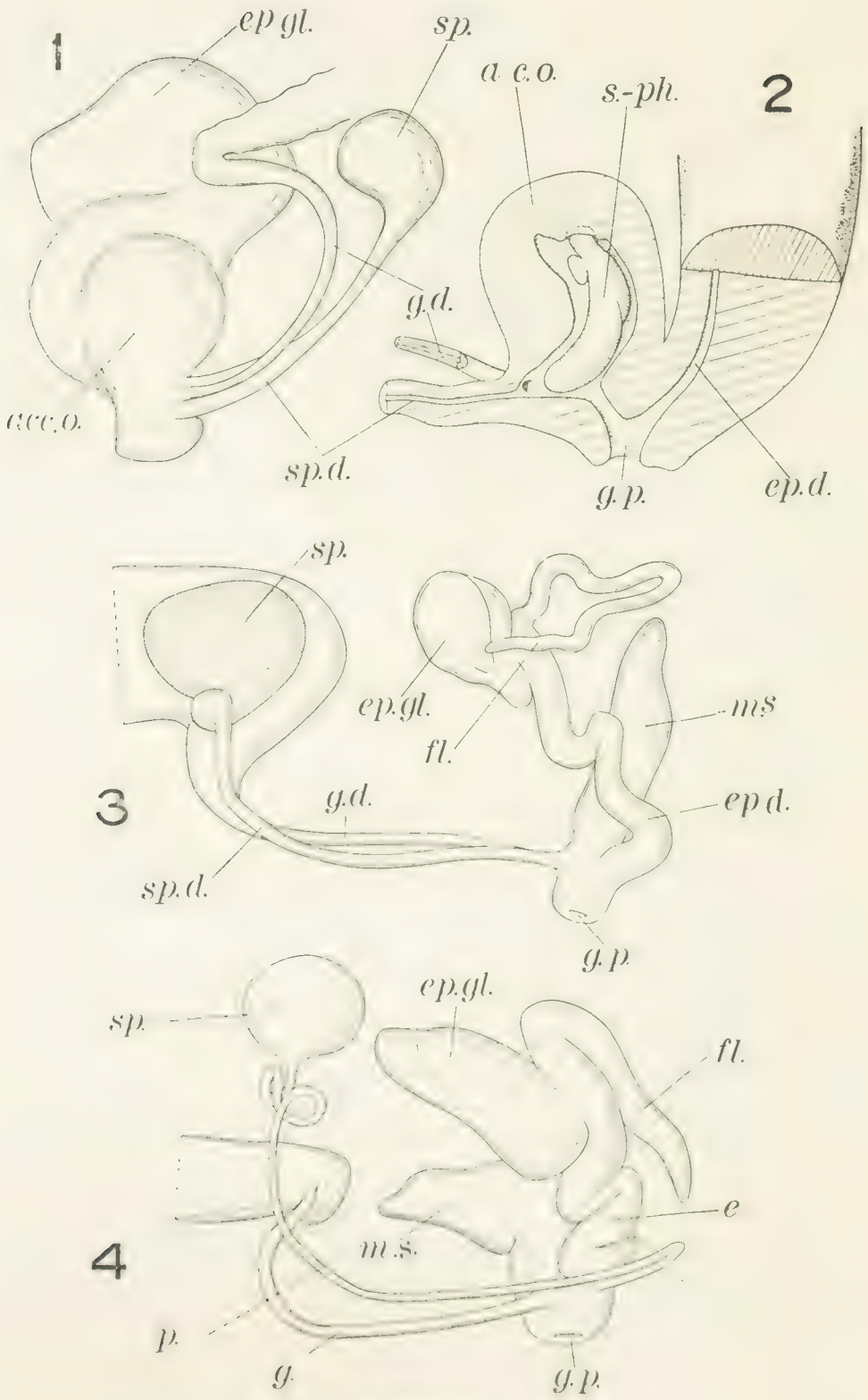
Anatomically the species agrees with the structure in *Siphonaria* s. str. (fig. 4).

Conchologically *S. currumbinensis* resemblances *S. japonica* Donovan. But this resemblance is only superfiscial the species being anatomically distinct. The resemblance to *S. parcicostata* Deshayes may, however, correspond to a close relationship. *S. parcicostata* differs from *S. currumbinensis* by having relatively few, in the frontal portion generally none, low and broad, distinctly dominating ribs. Yellow rays on the under side are never observed in *S. parcicostata*. This type of colour pattern occurs in the somewhat resembling species *S. belcheri* Hanley, which, however, belongs to subgenus *Liriola* and is not closely related to *S. currumbinensis* belonging to subgenus *Siphonaria*.

ACKNOWLEDGMENTS

I wish to acknowledge my indebtedness to the National Museum of Victoria for the loan of the above material, and through them Mr. R. Kenny, Mr. R. Endean and Professor W. Stephenson of the Zoology Department, University of Queensland, who collected much of it.

I also wish to express my gratitude to Miss J. Hope Macpherson, National Museum of Victoria, who has kindly assisted in obtaining this complementary material particularly through sending me some of Iredale's paratypes on loan.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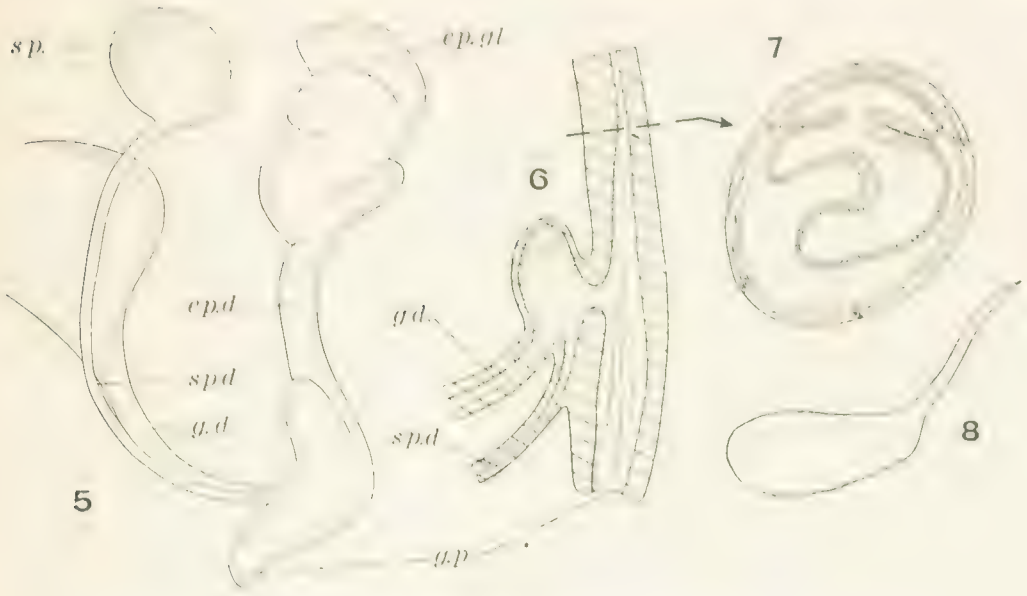
FIGS. 1–4.



FIGS. 5–8.

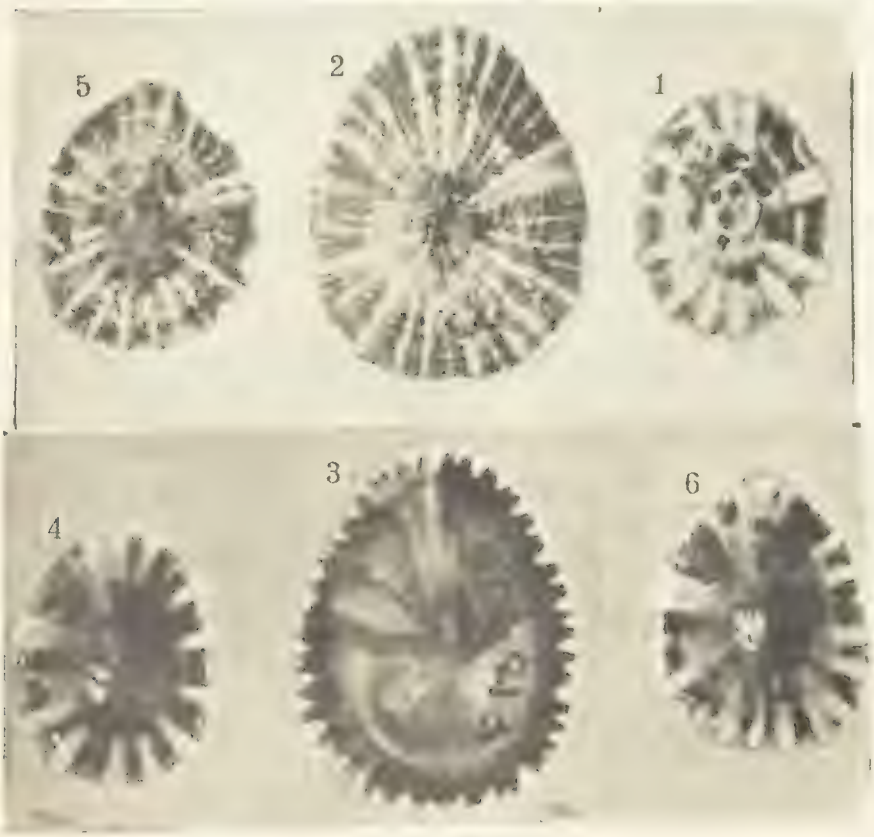


PLATE 1.

Literature

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Figs. 1–4.

Fig. 1. *Siphonaria virgulata* from Currumbin. Distal genitalia, medial view. Ca. 20.

Fig. 2. *Siphonaria virgulata* from Currumbin. Distal genitalia, lateral view. Parts of the walls removed. Ca. 30.

Fig. 3. *Siphonaria luzonica* from Rottnest Island. Distal genitalia, lateral view. Ca. 14. Note the pigmentation of the spermatheca.

Fig. 4. *Siphonaria currumbinensis* n. sp. from Currumbin. Distal genitalia, lateral view. Ca. 14.

acc.o. = accessory organ; ep.d. = epiphallus duct; ep.gl. = epiphallus gland; fl. = flagellum; g.d. = gonoduct; g.p. = genital pore; m.s. = muscular sheath; sp.=spermatheca; sp.d.=spermathecal duct; s.-ph=spermatophore.

Figs. 5–8. Siphonaria zealandica from Port Jackson.

Fig. 5. Distal genitalia, lateral view. Schematic. Ca. 8.5.

Fig. 6. Longitudinal section through most distal parts of genitalia. Schematic. Ca. 14.

Fig. 7. Cross section through epiphallus duct. Schematic. Ca. 60.
Peripheral area = muscles; dotted area = mainly connective tissue.

Fig. 8. Outline of spermatophore. Ca. 33.
Same abbreviations as in Figs. 1–4.

Plate 1 figs. 1–6. *Siphonaria (Siphonaria) currumbinensis* n. sp., 2·5 times natural size. Figs. 1–4, from Currumbin, Queensland (figs. 2–3, the holotype). Figs. 5–6, from Noosa, Queensland. In figs. 1, 2, and 5 dorsal view, in figs. 3, 4, and 6 ventral view. All shells with frontal end directed upwards.

BIRDS OF THE MACQUARIE MARSHES, NEW SOUTH WALES

By Roy P. Cooper, Hon. Associate in Ornithology, National Museum of Victoria

Ornithologically the Macquarie Marshes, that vast area of low-lying country adjacent to the Macquarie River, and subjected to periodical floodings, is as little known to-day as it was at the beginning of the century.

Very few, if any, accounts have been published of the prolific bird life of the area, and for some unknown reason, it has been overlooked by present day ornithologists. How different is the position regarding the swamps of the Moree Watercourse, the Riverina, and the Murray River!

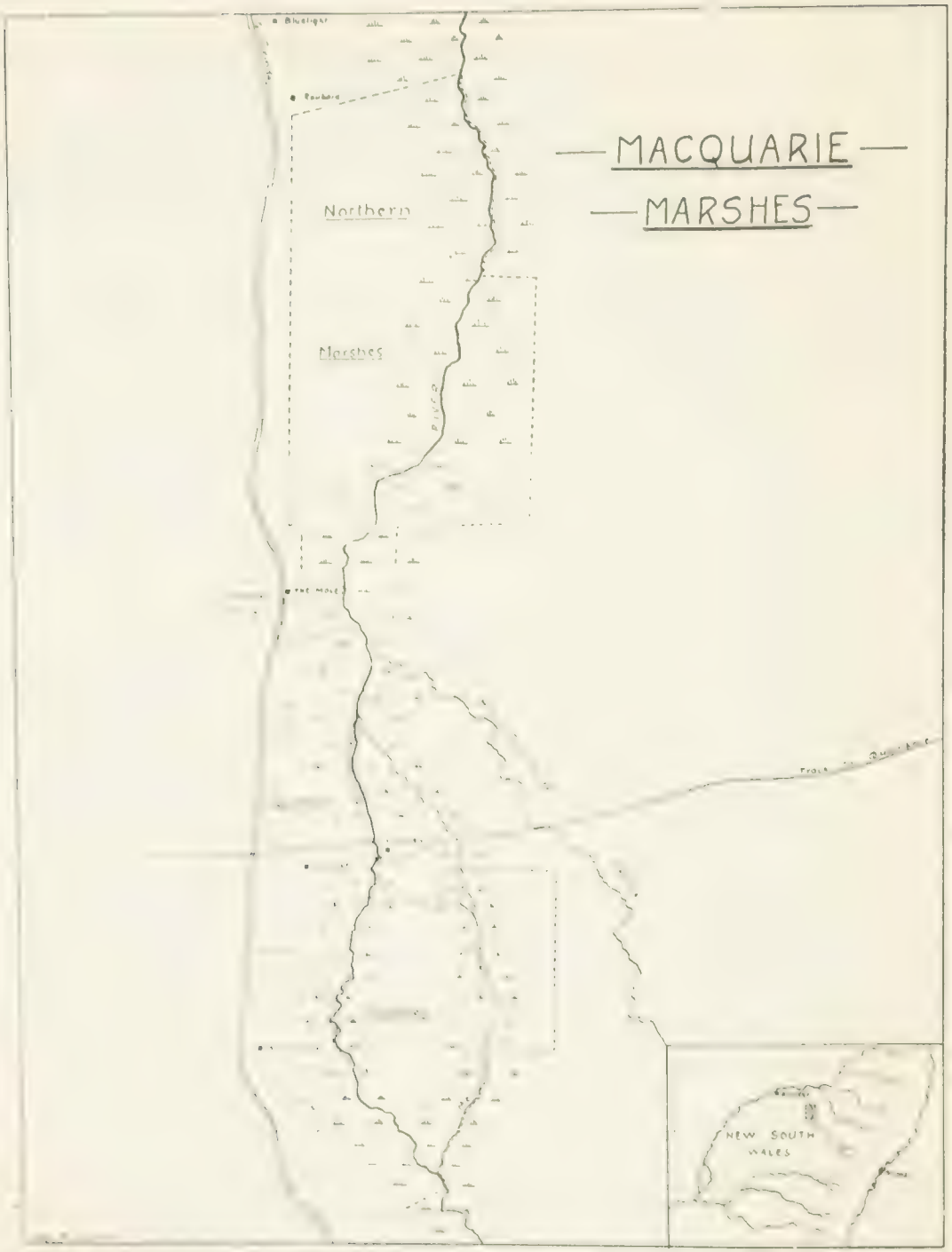
The main references to the bird life of this area, are contained in A. J. North, " Nests and Eggs of Birds found Breeding in Australia and Tasmania ", 1901–1914, (four vols.). Throughout the pages of these volumes references are made to correspondence with a Mr. S. Robinson.

Robinson lived at Bathurst, and made several visits to the Marshes at Buckiinguy Station towards the end of 1896. His son was apparently living in the area, as Robinson mentions that " —when leaving for home I asked my son to keep a good lookout every week, and let me know the result,—" (North, Vol. IV., p. 7.). Unfortunately no complete account of Robinson's observations or collections appears to have been published, and obviously North would only have used notes that would be of interest to him.

In recent years, Mr. Lance B. Peacocke of Dubbo, has taken a very active interest in the Marshes and the protection of its avifauna. Peacocke, who is attached to the New South Wales Government Lands Department, is responsible for the Crown lands, and his knowledge of the area is unsurpassed. Fortunately for Australian Ornithology, he is an enthusiastic bird student. On detailed maps of the area he kindly marked the breeding grounds of the ibis and other water birds.

The Macquarie Marshes commence some 50 miles below Warren on the Macquarie River, and continue downstream until nearing the junction with the Darling River. After heavy rains, the Macquarie overflows its banks, and many square miles of land are inundated by its floodwaters. Of this vast area, approximately 44,000 acres has been declared a sanctuary for birds and animals.

The reserve is divided into two main sections, known as the Northern Marshes and the Southern Marshes, the area in between being privately owned. Little wheat is grown, the land being used for the grazing of sheep and cattle.



Map.

Further up the river, beyond the town of Wellington, a large dam is to be constructed to impound the waters of the Macquarie for irrigation purposes. After completion, it will take approximately five years of average rainfall, to fill the dam. This means that the Marshes will receive only local floodings, which are not sufficient to cover the normal areas. Consequently large tracts of lignum, on which the ibis nest, may die and these birds will either cease to nest or be driven from the district. A committee has been formed to endeavour to overcome this problem, and to maintain the floodings in the Marshes while the dam is filling.

In November, 1948, a party consisting of Messrs. N. Chaffer, J. S. P. Ramsay, and the author visited the area, spending three weeks in studying and photographing the birds. The swamps are so extensive, that in this short period we were, even with the information supplied to us by Mr. Peacocke, only able to cover a part of the area. Consequently our observations must be regarded as incomplete. It will be necessary for more visits to be made and observations published, before a comprehensive survey can be made.

The following list of observations of the species observed covers those found on the swamps or the adjacent country. Although a total of 136 species was recorded, it cannot be classed as a full list of the birds frequenting the areas, but will serve as a foundation on which future observers can build.

List of Birds Recorded

Dromaius novae-hollandiae (Latham). Emu.—Seen on many occasions. While driving across one of the barren areas of the stock route, we observed a bird about a quarter of a mile distant, moving slowly away as we approached. When the car stopped, the Emu also halted and stood gazing in our direction. Having heard many stories of how an Emu will be attracted by curiosity to an unusual object, we sat very quiet and one of us waved a handkerchief out of the window. Within a few minutes the bird began to walk slowly in our direction. When within 30 yards, it stopped and commenced to circle around the car. It finally became alarmed at our movements as we attempted to photograph it, and ran off at a fast speed. It did not run far, however, and twice more it was attracted to the car by the same deception. A number of family parties was seen, the stately adult marching ahead of a column of half-grown young. The latter varied in number from three to five birds, and all appeared to be about 2 feet high. Some were in the striped, juvenile plumage, while others, apparently no older, were in the grey of the adult. When crossing the paddocks on Willancorah Station, one half-grown chick followed us for some distance.

Turnix velox (Gould). Little Quail.—As a result of the bounteous rains the paddocks were heavily grassed, and here the quail were very common. They would rise from almost under our feet and, after a rapid flight of 20 to 30 yards, drop down into the grasses again. The density of the cover and the short, rapid flight made identification difficult. There is no doubt that there was a number of species present, but we could only positively identify the Little Quail.

Geopelia striata (Linné). Peaceful Dove.—Between Warren and Buckiinguy Station, this species was very common and was observed in all the surrounding areas. Beyond Buckiinguy, although the flora appeared to be the same, it was not recorded; its place being taken by the Diamond Dove (*G. cuneata*). This latter species in turn, was not observed until after passing Buckiinguy, and it then became very common. This appeared to be most remarkable, as there is no reason why both species should not have mixed. No doubt the two species were in both areas but, by some mischance, they were not observed by us.

Geopelia cuneata (Latham). Diamond Dove.—Very common after passing Buckiinguy. (See notes under previous species.) A heavy growth of a weed, known locally as the Mustard Weed, was on each side of the main road between Roubaix and Bluelight Stations, leaving only sufficient room for a single vehicle to pass. The seed pods were ripening and thousands of seeds were scattered on the road. Such a plentiful supply of food was not overlooked by the birds, and many species were seen feeding along the road. The Diamond Dove was particularly common, and on two occasions many hundreds were observed. Nesting apparently had been completed for the season, as many of the birds were moving around in small flocks, while others did not give any indications of breeding.

Geopelia humeralis (Temminck). Bar-shouldered Dove.—At the Moree Watercourse, we had found this species to be common, and as the country at the Marshes was similar, we had expected it to be plentiful. However this was not the case, and it was only on rare occasions that we heard or observed it, and then only singly.

Ocyphaps lophotes (Temminck). Crested Pigeon.—Although this species was common between Dubbo and Narramine, it was only sparsely distributed around the Marshes. It was observed in a number of places but never in any quantity. No signs of nesting activities were recorded.

Porzana fluminea (Gould). Spotted Crake.—Observed among the lignum bushes at Bluelight Swamp. It was found where the lignum was growing in the mud, over which it would

run with great rapidity. A pair frequented one patch of lignum, and although I often heard and saw the birds, I could not locate a nest. The bushes were too dense for observation and too tough to push through. North records Robinson as having found the bird breeding at Buckiinguy Station and the Marshes, but does not mention having seen the Spotless Crake (*P. tabuensis*).

Tribonyx ventralis (Gould). Black-tailed Native Hen.—With the exception of the Ibis, this species was undoubtedly the most common bird. It occurred in flocks of hundreds and was freely distributed on the grasslands near the edge of the water. On the road between Willie and the Mole Stations, a flock of many hundreds was disturbed. A spur of the swamp came almost to the road and the surrounding paddocks had been well grazed. The birds were along the road for several hundred yards and also in the nearby paddocks. As we drove up they commenced to make for the protection afforded by the rushes in the swamps and soon they were in full retreat. Apart from their size and colour, it was difficult to appreciate that they were wild birds, for their actions were similar to a flock of domestic fowls that had been alarmed. Near our camp on the edge of the Bluelight Swamp, the birds were freely distributed all along the edge of the water, and they were always to be seen in the paddocks searching for food. When disturbed they made back for the reeds growing in the water. When we came out of the swamps we were between the birds, feeding in the paddocks, and the water, but invariably they would cut across our path at an angle and make for the reeds. We did not see any chickens or any signs of nesting; all the birds were fully grown.

Gallinula tenebrosa (Gould). Dusky Moorhen.—Not common. There was a large stretch of water near the Roubaix Homestead, and several Moorhens were seen along its edges. It was also observed in small numbers on the Bluelight Swamp.

Porphyrio porphyrio (Linné). Eastern Swamphen.—In the large swamp opposite the Mole Homestead, small numbers of Swamphens were seen. A few odd birds were also observed on the Bluelight swamps. Not recorded elsewhere.

Fulica atra (Linné). Coot.—Observed in several parts of the swamps, and also along the banks of the Macquarie River near Willancorah, but not in any large numbers.

Podiceps novae-hollandiae (Stephens). Little Grebe.—This was a common bird often being observed on the clear stretches of water.

Podiceps poliocephalus (Jardine and Selby). Hoary-headed Grebe.—In a quiet backwater of the Bluelight swamps, near the main road to Carinda, many waterfowl, including several of this species, were observed. This was the only time that we saw this grebe.

Phalacrocorax carbo (Linné). Black Cormorant.—On the Macquarie River, near Willancorah Homestead several of these birds were seen. Not recorded elsewhere.

Phalacrocorax sulcirostris (Brandt). Little Black Cormorant.—Freely distributed over most of the waterways. At Bluelight swamp, several parties were observed flying in formation overhead.

Phalacrocorax melanoleucos (Vieillot). Little Pied Cormorant.—Only observed on one stretch of the Macquarie River, where a small party was seen at Willancorah.

Anhinga rufa (Daudin). Australian Darter.—Although this species should have been seen throughout the marshes, we only recorded two birds from the Macquarie River at Willancorah Station. The male was in full plumage, the dark colouring showing strongly in the sunlight. Unable to locate nest.

Pelecanus conspicillatus (Temminck). Australian Pelican.—Often seen flying overhead. At the Ibis rookery on Bluelight swamp, I was in a " hide " endeavouring to photograph the Ibis, when two Pelicans landed on a stretch of water nearby. They took no notice of the " hide " and proceeded to swim about and thrust their long bills under the water. It was not possible to ascertain if they were catching fish. They mixed freely with the Ibis who made no attempt to attack them.

Chlidonias hybrida (Pallas). Whiskered (Marsh) Tern.—These birds were often seen flying over the paddocks at Willie Station. They were in large numbers and were often accompanied by Gull-billed Terns (*Gelochelidon nilotica*). As they flew they were widely dispersed and appeared to be feeding. North (Vol. 4, p. 302), records that they feed on centipedes, grasshoppers and other land insects in a similar manner as they feed over water. A small party of fifteen to twenty birds was also observed flying over the paddocks of the Mole Station. No signs of nesting were observed.

Gelochelidon nilotica (Gmelin). Gull-billed Tern.—This species was also seen in large numbers flying low over the paddocks on Willie Station, usually accompanied by Marsh Terns (*Chlidonias hybrida*). They would fly widely scattered and appeared to drift in one direction and shortly afterwards move

back again. Apparently they came from the swamp areas, but we did not see them on any of the waterways. On November 21st large numbers of both species were over the paddocks, although the temperature was over 100 in the shade, and most of the land birds were very subdued.

Erythrogonys cinctus (Gould). Red-kneed Dotterel.—Numbers of these birds were on the foreshores of the swamps and on the lignum islands at Bluelight, but were not recorded elsewhere. One pair was always observed at the point where we entered the swamps, but we could not locate the nest.

Lobibyx novae-hollandiae (Stephens). Australian Spur-winged Plover.—A large number of approximately one hundred birds was disturbed from the swamps opposite the Mole Homestead. They were often seen in the paddocks and on the edges of small waterholes at the side of the road. One pair was accompanied by three half-grown young birds. Often heard calling at night.

Zonifer tricolor (Vieillot). Banded Plover.—Often seen in the short grassy paddocks. Sometimes they were in singles or pairs, and occasionally in flocks of up to twenty birds.

Charadrius melanops (Vieillot). Black-fronted Dotterel.—Only recorded in small, very widely distributed, numbers. One pair was nesting on a patch of bare, black soil, surrounded by trees on the banks of the Macquarie River. The nest was only 50 yards from the Homestead at Willancorah. It is amazing how these birds always construct such a perfectly camouflaged nest. Quite a substantial collection of pieces of black soil had been gathered together to form the nest, and the three eggs were marked in keeping with the surroundings.

Himantopus himantopus (Linné). White-headed Stilt. This species was not as common as we had expected. On the Bluelight swamps, a small party of up to fifteen birds would alight in a clear stretch of water to feed. They were observed here on a number of occasions, and they usually arrived in one party. When disturbed they flew away, but not always in the same direction. I was particularly anxious to find their nests, but saw no birds away from this spot. When we first entered the swamp the birds arose, uttering their curious barking notes, before we were aware of their presence. We fully expected to find that they had been disturbed from their nests, but this was not the case. Subsequently, I spent many hours watching these birds but, discovered, curiously enough, their constant return to this area was only for food.

Stiltia isabella (Vieillot). Australian Pratincole.—We had looked forward to seeing this species for many years. As Ramsay remarked, it was remarkable that, with a combined total of almost 90 years of bird observing and extensive wanderings in the inland, not one of us had seen a pratincole. Consequently, when we observed one of these birds standing on the road, in the path of the car, it did not need any urging for the driver to apply his brakes suddenly and hard. Robinson (North) found them nesting at Buckiinguy Station during October, 1896, and collected four sets of eggs from nests built on the bare ground, and all within a circle of 30 yards diameter. During our trip we observed them on several patches of bare ground on the stock route, and also found a half-grown and two very young birds. We spent many hours observing and photographing these interesting birds, but as the notes have been published in full by Chaffer (*Emu*, vol. 49, pp. 1–3), they will not be repeated here.

Choriotis australis (J. E. Gray). Australian Bustard.—We did not observe these birds during our visit, but MacLeash of Willancorah Station and Winter of Willie Station, confirmed their presence in the district. They both observed them near Willie Station while we were away at Bluelight.

Grus rubicunda (Perry). Brolga.—This was another species that we did not actually see, but there was no doubt, from the information given to us, that they occurred in the district. At Willancorah Station the birds regularly came into the paddocks within a few yards of the homestead, where they could be observed from the house.

Plegadis falcinellus (Linné). Glossy Ibis.—The finding of this species nesting was one of the highlights of the trip. We first saw the birds feeding in the dry paddocks on Willie Station, and later a party of twenty birds was seen in the swampy area opposite the Mole Homestead.

Robinson does not mention this species when writing to North, but states, "I am forwarding you an account of two species of ibis; the Straw-necked and the White, I found breeding towards the latter end of 1896 near Buckiinguy, New South Wales." Peacocke (*in litt.*) has records of a number of breeding colonies throughout the area, which have been in use for many years.

Of the two large colonies of breeding ibis that we visited at Bluelight and Monkeygar Creek, the Glossys were only nesting at the latter place.

Previous reports mention that these birds build nests in trees similar to those constructed by herons and egrets, and are placed in upright forks or in bunches of twigs.

We found them nesting in the lignum in similar positions to many of the Straw-necked and White Ibis. All these species were nesting together, even in the same small clump of lignum. Where this occurred, the nests of the two larger species were constructed on the top of the bushes, and those of the Glossy placed on the sides and close to the water.

The nests were much more solidly constructed than those of the other species. Instead of being made of gum leaves, as found previously by earlier observers, they were constructed of pieces of shredded sags which were growing nearby. These were tightly woven into a solid nesting hollow, but were loosely placed towards the edges of the nest. Before constructing the nest proper the lignum was bent over to form a solid base on which the nest was placed. There was no possibility of the nest falling off, for the long pieces of materials were woven in and out of the lignum. One nest which I tried to remove, could not be shifted without almost totally destroying it.

A few nests had small bunches of gum leaves in the bottom of the nesting cavity, but these appeared as a lining and not as part of the main construction.

Most of the nests contained either two or three pale-blue eggs, of which surprisingly few showed any signs of mud markings from the feet of the birds. As the feeding habits of the three species are similar, and all were observed in the muddy areas, it would appear that the Glossy was more careful when settling on the eggs.

Following up this assumption, careful note was made of the manner in which the bird alighted on the nest. Eighteen nests were under observation from the hiding tent. On each occasion that a parent bird returned it was not seen to actually alight on the nest. Usually it landed on a low twig or in the shallow water and then walked up to the nest and settled on the eggs. It was always careful to see that it did not actually stand on the eggs.

Other nests contained young in various stages of growth, but no birds old enough to leave the nests were observed.

The colony was a comparatively small one, and apparently breeding had not been in operation long. Nests were being constructed in the lignum bushes on the outskirts of the colony as new arrivals commenced to build.

Most birds shield the young from the direct rays of the sun by means of their body, and outstretched wings raised so as to allow a passage of air to pass underneath. The Glossy, in addition to this action, provided another manner of cooling. After

sheltering the young for some time, they would step into the water and thoroughly wet themselves in the same manner in which most birds bathe. Returning to the nest they shook themselves vigorously and splashed the water over the young and then sheltered them from the sun again.

For long periods, while at the nest or resting nearby, the birds would sit with every feather raised, evidently to obtain all the air currents possible. This habit, or that of wetting the feathers, was not observed in either of the other species.

After arriving with food the parent would feed the young by regurgitation, and then commence to brood. Following a period of one half to one minute it would raise itself up and feed the young ones again. This procedure would be repeated, at approximately the same intervals until they were fed six to seven times. When all the food was gone the bird would step into the water, and laying its bill horizontally along the surface, allow the water to enter its throat. I have never seen any bird drink in this manner. Previously I have observed long-billed birds thrust their bills deep into the water and, after closing the bill, lift it vertically into the air, allowing the water to run down the throat.

Is this habit peculiar to the Glossy Ibis, or is it because of lack of field observations?

In flight the Glossy appears to be only about half the size of the White or the Straw-necked. The legs of all three species are carried straight out below the tail. Those of the latter two species are only a little longer than the tail, but in the case of the Glossy the legs are almost twice the length of the tail.

Threskiornis moluccus (Cuvier). White Ibis.—This species was common through the swampy areas. It was breeding in both the colonies (see previous species) and also in small numbers in isolated spots in the thick belts of lignum. At the Bluelight rookery *moluccus* kept apart from *spinicollis*, and bred thickly on island clumps of lignum. At Monkeygar Creek they bred freely on the same bushes as both the other species.

The call is similar to that of the Straw-necked Ibis, but is more powerful and deeper.

Breeding was in all stages—building, nests, eggs, young and young out of the nest. They were breeding in lesser numbers than *spinicollis*, being roughly in the ratio of one to ten.

Threskiornis spinicollis (Jameson). Straw-necked Ibis.—This was the common ibis of the marshes. They were observed on many occasions, both in the paddocks and in the swamps. At the nesting colonies they were in far greater numbers than the other species.

The feeding habits of the three species of ibis were similar, and all would feed the young five to six times, in between sheltering them from the sun.

The call is either a single or a double, deep note. Occasionally three to four notes are uttered. When the double note—the common one—is used the emphasis is on the last note, which is much deeper. The alarm call is a loud, single note, which is promptly taken up and acted upon by the nearby birds.

This species had been breeding for some time as many young birds were observed in the centre of the colony, walking about the waters and feeding themselves. They looked almost like the adults, except for the shorter, immature bill.

We had been informed by Peacocke that the birds would be nesting in thousands when we were present, but that later they would be nesting in hundreds of thousands. During our stay many new birds arrived and the nesting area rapidly expanded.

Platalea regia (Gould). Royal Spoonbill.—Not common. Near the Bluelight swamp one of each species of the spoonbills were seen flying together overhead. One pair was found by Ramsay, breeding in the sags near the ibis rookery on Monkeygar Creek.

Platalea flavipes (Gould). Yellow-billed Spoonbill.—Only a few records were made of this species. In a swampy area, near the Carinda-road, a number were seen in trees in the company of egrets, but there were no signs of nesting. The only other record was that recorded under *regia*. There was no doubt that both spoonbills were nesting in the area, which was most extensive, but we did not find their breeding places.

Egretta intermedia (Wagler). Plumed Egret.—We did not observe many of these birds. In the swamps near the "Mole" a party of six birds was feeding. Others were observed resting in trees near Carinda-road, beyond Bluelight. Robinson collected the eggs of this species in 1893 (North). After we left the area we received a letter, that had unfortunately missed us while we were at the Marshes, stating that they were nesting freely on Oxley Station.

Egretta alba (Linné). White Egret. This species was only observed on a few occasions. It was apparently breeding on Oxley Station.

Notophoyx novae-hollandiae (Latham). White-faced Heron.—Common throughout the area, being found on almost every stretch of water. It was not recorded by us as nesting, but we heard it was breeding on Oxley Station.

Notophoyx pacifica (Latham). White-necked Heron.—This species was common, being seen on many of the swampy areas, and often flushed from pools of water alongside the road. Our camp on Bluelight Station was placed along the banks of the main creek, which at that time was flooded. Nearby large gums were growing and in their branches these herons were nesting freely. All the nests were placed at great heights, some being over 100 feet from the ground.

Nycticorax caledonicus (Gmelin). Nankeen Night Heron.—This was another species that we just missed finding nesting. We had intended visiting the nesting areas of the herons that Peacocke had informed us were often in use at Oxley Station. Unfortunately, each time we passed the main gates we had some other object in view, until our time ran out and we left the area. In the letter subsequently received we were informed that the Night Herons were nesting in greater numbers than ever previously recorded, and that the branches were weighed down with the weight of the nests and the birds. We recorded them in widely separated areas, usually in small numbers.

Chenonetta jubata (Latham). Maned Goose.—Rain had recently fallen and many pools of water had formed beside the roads. Although the area of water in the surrounding country totalled many thousands of acres, for some unknown reason the wood-ducks preferred to gather at the small roadside pools. We repeatedly came upon small parties of up to twenty birds, and they usually stayed until the car was within 50 yards before flying away. Beside the road to Willanconah Station, on a large pool of water, we counted 50 of these birds in the company of twenty Plumed Tree-ducks (*Dendrocygna eytoni*).

Cygnus atratus (Latham). Black Swan.—Uncommon. Several were seen in the Macquarie River near Willanconah Station; on Monkeygar Creek and on the water among the ibis nests at Bluelight. A dead bird was impaled on the barbed wire of a fence running through the rookery. It had apparently been caught as it was taking off the water and, being unable to free itself, had perished.

Dendrocygna eytoni (Eyton). Plumed Tree-Duck.—On a rainwater pool, beside the road near Willie Station, we observed approximately twenty of these birds in the company of 50 Wood-ducks (*Chenonetta jubata.*) As we approached both species bunched together. They appeared as a solid mass as they stood in the shallow water in the shade of the trees. When we stopped the car about 30 yards away the birds remained very still and it was

not until we drew much closer that they took flight. North quotes Robinson as having found these birds nesting in the long cane grass during the month of September, 1893.

Anas superciliosa (Gmelin). Grey (Black) Duck.—This species was observed in singles, pairs or small parties throughout most of the swampy areas. It was not recorded breeding in the Marshes although we observed one bird, with a brood of young ducklings, on a creek farther east.

Anas gibberifrons (S. Müller). Grey teal.—Small parties were seen on most of the open waters of either the swamps or creeks. A dead bird was noticed lying beneath a strand of barbed wire near the edge of water. It had evidently collided with the wire when alighting upon or leaving the pool.

Malacorhynchus membranaceus (Latham). Pink-eared Duck. —On a backwater of the Bluelight Swamp, near the Carinda-road, these ducks were first observed. Ten birds were swimming in the clear stretch of water, in the company of many other species of ducks and other water birds. Several were also seen on a large expanse of water near the Roubiax Homestead.

Aythya australis (Eyton). Hardhead (Australian White-eyed Duck).—The observations made of this species are identical with those recorded for the Pink-eared Duck. It was observed on both the backwater and at Roubaix, but not recorded elsewhere.

Biziura lobata (Shaw). Musk-duck.—Ten of these birds were seen on the Bluelight backwater previously mentioned. The nearby swamps had little open water, being mainly covered with lignum. This area was part of a drainage creek. It was lined with large gums with a clear stretch of water some 50 yards wide by 300 yards long. Good cover was on both sides of the water, and we saw more species of ducks here than anywhere else.

Uroaëtus audax (Latham). Wedge-tailed Eagle.—Very rare. Throughout the whole of the trip of over 1,000 miles, we only recorded one bird seen near the Marshes, and two birds, perched on a large tree, a few miles west of Lithgow.

Haliæëtus leucogaster (Gmelin). White-breasted Sea-eagle.—Several of these birds were observed flying overhead, in different parts of the Marshes. They nest in the area but, although I was informed of one nesting site, we did not have the opportunity to visit it.

Haliastur sphenurus (Vieillot). Whistling Eagle. The most common bird of prey of the district. Breeding freely. At one nest, placed at a height of 60 feet in a gum tree, the young could

be seen standing on the edge. It was very common over the ibis rookeries, and undoubtedly took heavy toll of the eggs and young.

Elanus notatus (Gould). Australian Black-shouldered Kite.—Seen on several occasions hovering over the paddocks near the Marshes.

Falco longipennis (Swainson). Little Falcon.—One of these birds was observed sitting on a post of a culvert bridge. It did not fly as the car went past within a few yards.

Falco peregrinus (Tunstall). Peregrine Falcon.—Seen flying among the trees on Willie Station. It was later observed sitting quietly on a low limb of a Black Box (*Eucalyptus bicolor*). Although we stopped within 20 yards and surveyed it through field glasses, it did not take fright and fly away.

Falco berigora (Vigors and Horsfield). Brown Hawk.—Very common. Several nests were found, each being built high up in tall gum trees. While I was in the "hiding" tent among the ibis nests at Bluelight, a Brown Hawk settled in a nearby tree. The ibis uttered many cries of alarm, but made no effort to attack it.

Falco cenchroides (Vigors and Horsfield). Nankeen Kestrel.—Occurred in most of the areas visited, but was not common. Usually only one bird was seen.

Ninox novae-seelandiae (Gmelin). Boobook Owl.—Only heard once. At our camp between Wannon and Buckiinguy one of the birds was heard calling during the night.

Kakatoë galerita (Latham). White Cockatoo.—Seen in small numbers at several places. Not common.

Katatoë roseicapilla (Vieillot). Galah.—These birds were very common, being seen throughout the entire western country through which we travelled. In the grasslands as well as the stubble lands they were seen feeding in large numbers. They were very wary and would not permit a close approach being made without taking flight. Many of the dead trees appeared to be clad in a raiment of pink and grey when a flock of birds alighted upon it. We watched many birds for indications of nesting, without result. Does this mean that they had already finished breeding (November), or that they had not yet commenced?

Leptolophus hollandicus (Kerr). Cockatiel.—Recorded in singles, pairs, or small parties throughout the area. Flocks of up to fifteen birds were often seen feeding in the grasslands or flying swiftly overhead. Many were found in pairs and several nests were recorded. One pair was apparently nesting in a hollow

spout at the top of a tall, dead gum tree. They would always flush when a stick was scraped along the trunk of the tree, but took no notice when the tree was hit.

Aprosmictus erythropterus (Gmelin). Red-winged Parrot.—Widely distributed throughout the timbered country in singles or pairs. No flocks seen. In a small grove of trees in front of Buckiinguy Homestead, a beautiful fully-plumaged male was seen feeding on the seeds. It did not show any alarm at my presence, but leisurely continued to extract the seeds from the pods while I stood within a few yards.

Barnardius barnardi (Vigors and Horsfield). Ringneck (Mallee) Parrot.—Odd birds were seen throughout the timbered country. One pair was nesting on Willie Station.

Psephotus haematonotus (Gould). Red-backed Parrot.—Very common, the species being widely distributed. Generally seen in small flocks feeding on the ground among the seeding grasses. Nesting in a hollow limb high up in a tall tree.

Psephotus haemotogaster (Gould). Blue Bonnet.—Another common species, usually seen in singles or pairs.

Melopsittacus undulatus (Shaw). Budgerygah.—Large flocks were often seen. At Willie Station continuous flooding had killed a large area of timber—a considerable amount of which was still standing. Here we expected to find parrots breeding freely, but excepting for a flock of Budgerygahs feeding in the seeding grasses growing at the base of the trees, few parrots were seen.

Aegotheles cristata (Shaw). Owlet-Nightjar.—One of these birds roosted in a hollow in a tree near our camp at Bluelight. On several occasions we scratched the bark and the bird promptly came to the top of the hole and looked out. An examination of the hole did not reveal any signs of nesting. One evening, while at the shearers' hut at Willie Station, a bird was observed sitting upon a water pipe leading from a tank within a few feet of the doorway.

Dacelo gigas (Boddaert). Laughing Kookaburra.—Very common and widely distributed throughout the area.

Halcyon pyrrhopygia (Gould). Red-backed Kingfisher.—One of the most surprising features of the trip was the total absence of this species. We had recorded it on all previous trips west of the main Dividing Range, and it is generally classed as common in western New South Wales.

Halcyon sancta (Vigors and Horsfield). Sacred Kingfisher. —Two birds were seen feeding in an old gum tree and it was surprising the number of insects that they collected from the bark of the trunk and the larger limbs. They were also observed along a creek near Roubaix Station; among trees at Bluelight Station, and a single bird was seen in one of the paddocks. We had not expected to find so many birds of this species.

Merops ornatus (Latham). Rainbow-bird.—In the yard at Buckiinguy Homestead these birds in a small colony were nesting within 25 yards of the house. The ground was slightly uneven and bare of grass. The birds had tunnelled into the sides of small depressions which were only an inch or two deep. They flew in and out of the tunnels, while we stood nearby, without taking any notice of our presence. Only a few birds seen elsewhere.

Hirundapus caudacutus (Latham). Spine-tailed Swift.— While we were camped at Bluelight large numbers of Swifts were observed flying overhead on two consecutive evenings. They did not appear until after the sun had set and were still flying about when it had become too dark to observe them any longer. On the first occasion only *H. caudacutus* was observed, but the next evening both the Spine-tailed and the Fork-tailed species were seen.

Apus pacificus (Latham). Fork-tailed Swift.—Numbers seen flying over the camp at Bluelight on the 17th.

Cuculus pallidus (Latham). Pallid Cuckoo.—Seen, either singly or in pairs, throughout most of the area. No cuckoos' eggs or young birds were in any of the nests found.

Misocalius osculans (Gould). Black-eared Cuckoo.—A rare species. A single bird was seen near the camp at Bluelight.

Chalcites basalis (Horsfield). Horsfield Bronze-Cuckoo.— Only one adult bird seen or heard. This was at Willie Station, and was observed among a stand of stunted timber growing in the main paddock. There were a number of different species of birds nesting in these trees but none had been parasitized by cuckoos. Among the grasses, out in the open paddocks, a pair of White-winged Wrens (*Malurus leuconotus*) were feeding a young Bronze-Cuckoo (sp.) that had left the nest.

Hirundo tahitica (Gmelin). Welcome Swallow.—This species was very common and was often seen in large numbers around the buildings. Late one afternoon, while we were at the woolshed at Roubaix, many hundreds of this species, Tree-martins, (*Hirundo nigricans*) and Fairy-martins, (*H. ariel*) were seen flying about. When we first arrived at about 5 p.m. no birds were observed, but within a quarter of an hour many

birds began to arrive. They could be seen flying in from several directions, and hundreds of birds were in the sky. The first arrivals soon began to settle on the ridge, the gutters, or any other protruding portion of the building, and some flew into the shed. All the time more birds were arriving and their flight was similar to a flock of Woodswallows migrating. We watched closely to see if there were any swarms of insects flying around that may have attracted the birds, but we could not locate any, either inside or outside the building. When we left the locality at 6 p.m. more birds were still arriving, and we were unable to obtain the slightest clue to this peculiar behaviour.

Hirundo nigricans (Vieillot). Australian Tree-martin.—Large numbers of these birds were seen in several areas. They were nesting near Marra Creek and also at Willie Station. Between Bluelight and Roubaix Stations the road was overgrown with Mustard Weeds which were seeding freely, the pods dried and bursting. The seeds were falling onto the road and many birds were observed feeding on the bountiful supply. Late one afternoon hundreds of Tree-Martins were seen on one section of the road. Many hundreds more were seen at the woolshed at Roubaix, as recorded under the previous species.

Hirundo ariel (Gould). Fairy-martin.—A common bird which was nesting freely. The nests were under many of the culverts, and the birds would fly out as we drove along. Small nesting colonies were also located on the underside of large, leaning gums at Willancorah and Bluelight Stations. Many hundreds seen at the woolshed at Roubaix Station. See also under Welcome Swallow.

Rhipidura leucophrys (Latham). Willie Wagtail.—Freely distributed throughout the area. Many nests were found, some being built while others contained eggs or young. Only one nest was constructed in close proximity to that of a Peewee (*Grallina cyanoleuca*).

Seisura inquieta (Latham). Restless Flycatcher.—A limited number of birds observed. One pair was constructing a nest in a large gum tree growing in the swamps, in the midst of the Ibis colony at Bluelight. The nest was being built within a few feet of an occupied nest of a White-breasted Wood-swallow (*Artamus leucorhynchus*).

Microeca leucophaea (Latham). Jacky Winter.—Occurred in the timber in most of the areas visited. A nest was found built in a horizontal fork of a limb of a gum tree. This species was more widely spread than we had anticipated.

Petroica goodenovii (Vigors and Horsfield). Red-capped Robin. Although we had previously found this species widely distributed in similar types of country throughout Western New South Wales, only two birds were recorded on this trip. On the road past Willie Station a pair was seen in a small clump of trees—the male being in full plumage.

Melanodryas cucullata (Latham). Hooded Robin.—Although not occurring in any great numbers, these birds were seen in most of the timbered areas. A pair was constructing a nest on a piece of loose bark on the undersurface of a fallen tree. The log was held a few feet above the ground by having become wedged in the fork of another tree. This was in an area that had been subjected to periodical floodings and the water was still covering the ground underneath the nest.

Eopsaltria australis (Shaw). Southern Yellow Robin.—Very rare. Only one bird was observed and this was seen in the timber near our camp at Bluelight.

Pachycephala rufiventris (Latham). Rufous Whistler.—A solitary male bird was seen at Buckiinguy.

Colluricincla harmonica (Latham). Grey Shrike-Thrush.—Seen or heard at most of the main areas, but not common.

Grallina cyanoleuca (Latham). Magpie-Lark.—Freely dispersed throughout all the timbered country. Very common and nesting freely. Only one nest was found built close to that of a Willie Wagtail (*Rhipidura leucophrys*). Many of the nests were built in trees that were growing some distance away from water, while others were built on limbs that were hanging over the swamps. Considerable difficulty was experienced when attempting to photograph a pair of these birds, which had a nest built in a gum tree at a height of 15 feet. The camera was placed on top of a tripod extension ladder, and a hide constructed some distance away for concealment. Although young were in the nest the male would not return, and the female visited the young only twice throughout the day.

Falcunculus frontatus (Latham). Eastern Shrike-tit.—Small numbers seen in the timbered areas.

Oreoica gutturalis (Vigors and Horsfield). Crested Bellbird.—Widely distributed, either singly or in pairs. We spent many hours observing these birds in an endeavour to locate their nests. One bird was watched for two hours and followed over a wide area, but it would not go near the nest.

Coracina maxima (Rüppell). Ground Cuckoo-shrike.—At Willie Station a party of five birds was seen on several occasions. A close examination showed it to be a family party of two adults and three young birds. The barrings of the immature birds were most noticeable. Several birds seen in other areas, but no nests were found.

Coracina novae-hollandiae (Gmelin). Black-faced Cuckoo-Shrike.—The common cuckoo-shrike of the district. It was freely distributed throughout all the timbered country and numerous nests were found.

Coracina robusta (Latham). Little Cuckoo-Shrike.—An adult bird was observed in a gum tree at Bluelight Station. It was fully plumaged, showing only the black marking through the eye, and there was no doubt as to its identity. It was not seen again nor were any other birds of this species.

Lalage sueurii (Vieillot). White-winged Triller.—Very common in the timbered country and nesting freely. One nest was constructed in the main fork of a small gum tree at a height of 7 feet from the ground and contained three eggs. Another nest was being built on a horizontal forked limb of a Wilga (*Geijera parviflora*) at a height of 5 feet. When first discovered the nest was being built and it was noticed that the male played an equal part with the female in its construction. The full clutch of three eggs was eventually laid, each egg being laid early in the morning of three consecutive days. Other nests were found at heights of up to 40 feet.

Pomatostomus temporalis (Vigors and Horsfield). Grey-occurred in groups of up to fifteen birds and always kept close together. On Willie Station one party of fourteen birds was nesting in a clump of small gum trees, and they had constructed eight large nests. From their actions it was almost impossible to ascertain which particular nest was being used for the rearing of the young, and the trees were too slender to permit a closer investigation.

Pomatostomus superciliosus (Vigors and Horsfield). White-browed Babbler.—Common in most of the areas and nesting freely. A small party of birds had young in a nest built in a Wilga. Five birds were seen at the nest with food, and while one entered the remaining four birds waited outside for their turn to feed the young. Nearby were six other nests which were being used by the same party. One of these was a particularly large structure, being almost three times the size of the other nests.

Epthianura albifrons (Jardine and Selby). White-fronted Chat.—This species was extremely common, and was found in all the areas where the habitat was suitable. There must have been many thousands of these birds scattered throughout the area. No attempts were made to locate their nests, nor were any special observations recorded. In certain areas they mixed freely with the Crimson (*E. tricolor*) and the Orange (*E. aurifons*) Chats.

Epthianura tricolor (Gould). Crimson Chat.—We first observed this species on the side of the road between Marra Creek and Buckiinguy Station—two males and two females being seen. No indication of nesting was shown. They moved freely about the ground in the low bushes, and when disturbed flew up into a nearby tree. One male had selected a small branch on a tree as a vantage point, and it was seen repeatedly to return to this position. After leaving Buckiinguy they became very common and were to be seen in most of the roly-poly and saltbush areas. They also occurred in low shrubs and among tall grasses. In one of the paddocks at Willie Station the saltbush was only a few inches high. Here the three species of chats were often seen feeding, and as many as fifteen male Crimson Chats (*Epthianura tricolor*) five male Orange Chats (*E. aurifrons*), as well as females and young birds were observed at one time. They presented a delightful picture, as the brilliantly coloured birds moved among the blue-green saltbush, over the red-brown earth.

One of the paddocks, near the Macquarie River, had been flooded, and as the water had receded, a luxuriant growth of grasses and treefoil had sprung up. The treefoil was now dying and was a rich brown colour. In this area we found *tricolor* nesting. From our previous observations we had not expected to find these chats in this type of habitat and were somewhat surprised when we saw a male bird. At the time we were endeavouring to find the nest of one of the larks and did not pay very much attention to the chat. Previously we had spent many hours watching these birds and had decided, in view of the large number of plain birds seen, that breeding had finished. However, one of us noticed that it had food in its bill and the nest was soon found. It was built in a clump of brown treefoil and contained three young. Within 50 yards a second nest was located and in it were two young birds. This nest also was built in the dead treefoil. All the adult birds displayed great agitation at our presence and the broken wing trick, as well as fluttering along the ground in an apparent injured condition, was used to distract our attention from the nests. Next day a third nest, containing two young, was found. It also was built in a clump of dead treefoil. Unlike the other nests, which had been placed at the

base of the stalks, it was constructed near the top and immediately beneath the trunk of a fallen tree, which, at this point, was about a foot off the ground. The lip of the nest was only 2 inches from the bark of the tree and the birds had to crouch as they alighted. In no other area were any nests found or birds seen carrying food, or otherwise displaying nesting signs.

Epthianura aurifrons (Gould). Orange Chat.—Although the Orange Chat was seen in most areas it was in less numbers than either *albifrons* or *tricolor*. Many fully plumaged males were observed, often in the company of the White-winged Wren (*Malurus leuconotus*) and the Crimson Chat (*Epthianura tricolor*). Despite extensive observations, no nests were found. Many young birds were about and it would appear that the main breeding had been completed.

Aphelocephala leucopsis (Gould). Eastern White-face.—Of all the smaller birds the white-face was by far the most common. It occurred in almost every patch of timber or low bushes, often in scattered parties of up to 50 birds. A considerable amount of time was spent in observing this species and in trying to locate its nest. However, breeding appeared to have finished as not one bird was observed that showed any indication that a nest was nearby. It would have been interesting to have been present when nesting was at its height, as there did not appear to be many suitable nesting positions, that is, in relation to the number of birds seen, in the surrounding habitat.

Acanthiza uropygialis (Gould). Chestnut-tailed Thornbill.—Seen scattered about the area but not common. Several pairs were observed feeding young which had apparently only recently left the nest.

Acanthiza chrysorrhoa (Quoy et Gaimard). Yellow-tailed Thornbill.—This species was not common, only a few small parties being seen. No signs of nesting.

Cinclorhamphus cruralis (Vigors and Horsfield). Brown Songlark.—Freely distributed throughout the area, but not in any large numbers. We would regularly see single birds sitting on fence posts as we drove along the roads and often observed them in the paddocks. No signs of nesting.

Cinclorhamphus mathewsi (Iredale). Rufous Songlark.—One of the paddocks on Willie Station had recently been covered with the flood waters, most of which had now drained away. A heavy growth of Mustard Grass was underfoot, and there were many patches of dead Treefoil and tall green grasses. In this area the songlarks were very plentiful. We had been informed

that there were large numbers of the English Skylark (*Alauda arvensis*) in the district, but our informant evidently had confused this species with the Rufous Songlark, as no Skylarks were seen. We noticed a bird carrying food into a small area which was covered with 3 feet high Mustard Weeds. Excepting for the tall stalks of the weeds the ground was bare and we did not expect any difficulty in locating the nest. Despite our optimism all our efforts proved fruitless. We separated and watched from three different positions and tried to pinpoint the spot where the bird disappeared. Many times the bird brought food and it would arise within a few yards of where it alighted. Within this area it evidently fed the young, but we failed to find them. We searched every square inch on our hands and knees without success. As soon as we returned to our vantage points the bird would again drop down with food. I would not have thought it possible for a nest, or even young out of the nest, to be so cleverly concealed. It is possible that the young ones were hiding in some of the half-inch cracks that were in the ground and only came out when they heard the adult bird.

We later found a nest of this species a hundred yards distant, and it contained four young birds. Unlike the usual nests that are placed on the ground, this one was built in a very thick, prickly bush about 1 foot above the ground, and was exceptionally well concealed. It was only by watching the birds that it was located. The nest was typical of the species, excepting for the position in which it was built.

Despite the large numbers of these birds, we did not hear any of the long, sustained calls that are usually uttered when this species is nesting. Although the same notes, they were much shorter. The birds also appeared duller than those seen elsewhere, even in other inland areas. We took a full description for later verification with museum skins. We were all familiar with this species but the dullness of the birds, the shorter calls, and the unusual position of the nest found, made us doubtful of the correct identification.

Some days later, at Bluelight Station, Chaffer was fortunate to capture an adult bird, and we were able to definitely confirm our previous classification. The species was generally common in most of the grassy areas.

Megalurus gramineus (Gould). Little Grassbird.—Very common among the Lignum bushes and along the edges of the swamps in the tall grasses. On most of the waterways. Their plaintive call was heard continuously and they were often observed. Some birds were noticed carrying food, but no search was made for nests.

Cisticola exilis (Vigors and Horsfield). Golden-headed Fantail-warbler. Although we visited many suitable habitats, this species was not heard or seen until we were crossing the plains to Monkeygar Creek. The country had recently been inundated with water and the grasses were now very thick and long. As we drove along many birds were flushed from the nearby grasses. Sometimes they would alight on the tops of the taller grasses or soar high up in the air, singing as they ascended.

Malurus cyaneus (Latham). Superb Blue Wren.—Between Sydney and Narramine this species was the common wren, no other wrens being observed. After passing Narramine the country changed from wheatlands to grazing areas and no further Blue Wrens were seen. They were replaced by the White-winged Wren (*M. leuconotus*). We did not record any overlapping in the areas of either of these wrens.

Malurus leuconotus (Gould). Blue-and-White Wren.—Common in all areas where the roly-poly or Saltbush was growing. A number of small parties, comprising a fully-plumaged male and four or five brown birds, was observed. Nests were found, all being placed in the centre of roly-poly bushes. We were somewhat surprised to find a fully-plumaged male and a number of brown birds (approximately four) all busily engaged in feeding the young ones in one nest. Previously, when watching these birds, we had taken it for granted that it was a family party and that nesting had finished. Apparently the brood of the first nest help in attending to the wants of the young in the second nest. At Willie Station a female wren was seen feeding a young Bronze Cuckoo (sp.) that had only recently left the nest.

Malurus lamberti (Vigors and Horsfield). Purple-backed Wren.—Small numbers were recorded. At the homestead at Buckiinguy Station a male was seen feeding among the bushes growing in front of the verandah. It was later joined by a small party of brown birds. Near the Ibis rookery on Monkeygar Creek a male was observed moving about in the nearby snags. Another pair was seen in the open paddock at Willie Station.

Artamus leucorhynchus (Linné). White-breasted Wood-Swallow.—This water frequenting species of *Artamus* was observed in singles or pairs along most of the waterways. One nest contained three young, which were almost ready to leave. It was built in the hollow formed by the division of the main trunk of a large gum tree into four limbs. Another nest was constructed in the broken off portion of a large limb of another gum tree. Both of these trees were growing in the swamps.

Artamus personatus (Gould). Masked Wood-Swallow.—Very common in some areas. The birds were still moving about and showed little signs of settling down to nest. In many places they would be in large numbers one day, yet a few days later not a bird would be seen. The only sign of nesting was at Willie Station where a nest, containing fresh eggs, was found built in the top of a stump. Many birds were about and it appeared that they had settled in the area to breed. A week later only a few birds, including those at the above nest, were recorded. At Bluelight Station not a bird was seen until November 19th. On that day we awoke to find many hundreds in the surrounding country and more arriving. This species was in the company of the White-browed Wood-Swallow (*A. superciliosus*) but, contrary to my previous records, in much greater numbers. This preponderance of *personatus* was general in all the areas.

Artamus superciliosus (Gould). White-browed Wood-Swallow. Movements of this species were typical of *personatus*. At Willie Station a few nests, containing eggs, were found, but generally the birds were moving about the country.

Artamus cinereus (Vieillot). Black-faced Wood-Swallow.—As we neared Buckiinguy on the forward journey a number of *Artamus* were seen perching on the limbs of dead Wilga trees that were standing among a growth of low bushes. We were surprised to find all these species, *personatus, superciliosus,* and *cinereus,* present in roughly, the proportions of 3—2—2. *Cinereus* occurred throughout most of the more open types of timbered country, and in certain places was nesting freely. Nests were placed in various situations—tops of stumps; in thick clumps of mistletoe; low bushes, and in a dead stump that was covered with a thick growth of honeysuckle. One set of three eggs showed distinct variations in the markings. Two of the eggs were thickly marked at the larger ends with red, purple, and brown, forming a heavy zone. The third egg was lightly marked at the smaller end with the remainder white, very faintly spotted.

Artamus cyanopterus (Latham). Dusky Wood-Swallow.—A few birds were found in most areas. Usually two birds would be together and nesting was in full swing. The nests, which were built in the usual positions, contained either eggs or young. Several mottled young birds were observed, being fed, away from the nest.

Climacteris picumnus (Temminck). Brown Tree-Creeper.—This was the only species of tree-creeper observed. From Warren to Buckiinguy and Willie Stations it was very common and nesting freely. Not recorded beyond Willie Station.

Dicaeum hirundinaceum (Shaw). Mistletoe-Bird.—Only observed at Marra Creek and Willie Station. They were often seen among the wilgas near Willie Homestead and were feeding on the mistletoes that parasitized these trees.

Pardalotus ornatus (Temminck et Laugier). Eastern Striated Pardalote.—Very few pardalotes were seen or heard. In the paddock at Bluelight Station a pair was found nesting in a hollow tree. The entrance was through a very small hole and the bird had difficulty in entering or departing. It contained young who were fed regularly with insects by both adult birds.

Zosterops lateralis (Latham). Grey-breasted Silvereye.—Not common. A small party seen in the Wilgas near Willie Homestead.

Grantiella picta (Gould). Painted Honey-eater.—Several birds seen feeding on the berries of mistletoes growing on Wilga trees. Uncommon.

Meliphaga virescens (Vieillot). Singing Honeyeater.—Several birds seen feeding on the blossoms of the Black Box (*Eucalyptus bicolor*). Widely distributed but not common.

Meliphaga penicillata (Gould). White-plumed Honeyeater.—Very common throughout the entire area. Generally seen in the large *Eucalypts* where they fed extensively on the flowers or insects. Breeding freely.

Myzantha melanocephala (Latham). Noisy Miner.—Common throughout the district. Occurred in roughly the same numbers as the Yellow-throated Miner, (*M. flavigula*). Several nests found.

Myzantha flavigula (Gould). Yellow-throated Miner.—Freely distributed over the entire timbered area. No nests recorded although regular observations were made.

Acanthagenys rufogularis (Gould). Spiny-cheeked Honeyeater.—Only one bird of this species was recorded. It was observed by Chaffer in a Black Box near Willie Homestead. In other parts of inland New South Wales, where the habitat was similar, we had found them to be common, so their lack of numbers in this area was surprising.

Entomyzon cyanotis (Latham). Blue-faced Honey-eater.—Another uncommon species. One bird was seen in the trees near the entrance gates to Roubaix Homestead.

Philemon citreogularis (Gould). Little Friar-Bird.—I have not seen these birds in such numbers in any other part of inland New South Wales. We counted up to 30 birds in one party in a thick patch of trees. Our visibility was limited

by the surrounding foliage, and many other birds were undoubtedly in the area, widely distributed throughout the timbered areas and nesting freely. Many were seen carrying food to nests built high up in the gum trees.

Anthus novae-seelandiae (Gmelin). Australian Pipit.—Numbers seen in the open paddocks and along the edges of the road.

Zonaeginthus guttatus (Shaw). Diamond-Firetail.—Small numbers seen in several areas. Not common.

Poephila guttata (Vieillot). Zebra (Chestnut-eared) Finch. Small flocks.

Poephila modesta (Gould). Plum-headed Finch.—In the paddock of a property adjoining Bluelight Station a small party of six of this species was observed feeding in the tall grasses. Several males were present. They were very quiet and moved slowly among the grasses. I had been watching a Crimson Chat (*Epthianura tricolor*) for ten to fifteen minutes before I was aware that some small birds were among the grasses, in a direct line between the chat and myself. Even then I had to move closer and disturb the birds before it was possible to identify them. Not recorded elsewhere.

Oriolus sagittatus (Latham). Olive-backed Oriole.—Several birds seen, among heavy foliaged trees beside the road, when we were nearing Buckiinguy. No other records.

Struthidea cinerea (Gould). Apostle-Bird.—Very common in the timbered country—nesting freely. A large party which contained many young ones, was always around the huts at Willie Station. They would come up to the door of the hut for scraps of food.

Chlamydera maculata (Gould). Spotted Bower-bird.—A number of bowers were found around homesteads and in the timber. A favourite site for the bower was under the branches of a tree, where they drooped low to the ground. At Bluelight a bird appeared to be sitting on a nest in a clump of mistletoe. It was near the top of a tall gum tree and the bird was seen frequently in the same position.

Corvus coronoides (Vigors and Horsfield). Australian Raven.—From records this is apparently the *Corvus* of the area. It was very common and widely distributed.

Corvus bennetti (North). Little Crow.—Near Narramine Ravens were common and were seen feeding on the carcasses of dead rabbits on the road. One bird appeared to be smaller, so we stopped the car for closer observation. It alighted on the

road and, in the company of Magpies, commenced to feed on a rabbit. It did not appear to be any larger than the Magpies, and when a Raven joined the group the difference in size was most noticeable. Another bird was observed flying. Not recorded elsewhere.

Corcorax melanorhamphus (Vieillot). White-winged Chough.—Parties of these birds were frequently seen in the timbered areas, general throughout the district. Several nests were found at which a number of birds were in attendance.

Cracticus nigrogularis (Gould). Pied Butcher-Bird.—Widely distributed in singles or pairs. More common than the Grey Butcher-Bird. (*C. torquatus.*) No signs of nesting.

Cracticus torquatus (Latham). Grey Butcher-Bird.—Small numbers seen in the south-eastern portion of the Marshes, around Buckiinguy Station and Marra Creek.

Gymnorhina tibicen (Latham). Black-backed Magpie.—Very common. Occurred in all the paddocks and timber but rarely seen in the swamps. A number of nests found.

PLATES 1–18

1. The barren stock-route—haunt of the Pratincole.
2. Stunted saltbush plains.
3. Three foot high grass in paddocks typical of the whole area after the floods had receded.
4. A flooded backwater on the Carinda-road.
5. White Ibis feeding young in nest.
6. Straw-necked Ibis at nests.
7. Young Straw-necked Ibis.
8. Egg and Young of the Glossy Ibis.
9. Budgerygah at entrance to nesting hollow.
10. Glossy Ibis standing near the nest.
11. Nests of Glossy Ibis (lower left) and Straw-necked Ibis.
12. A newly hatched Glossy Ibis.
13. Pratincole on the edge of the stock-route.
14. Young Pratincole squatting in short grass.
15. Glossy Ibis on nests; Straw-necked Ibis nesting above.
16. Straw-necked, White, and Glossy Ibis in trees above nesting colony.
17. Straw-necked and White Ibis at nesting colony.
18. Peewee at nest in gum immediately above the swamps.

PLATE 1.

PLATE 2.

PLATE 3.

PLATE 4.

PLATE 5.

PLATE 6.

PLATE 7.

PLATE 8.

PLATE 9.

PLATE 10.

PLATE 11.

PLATE 12.

PLATE 13.

PLATE 14.

PLATE 15

PLATE 16

PLATE 17.

PLATE 18.

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